microwave section

section one

1

Sanders

W. H. SANDERS (ELECTRONICS) LIMITED

Sanders

INDEX

precision calibrated attenuators

CA 16/1

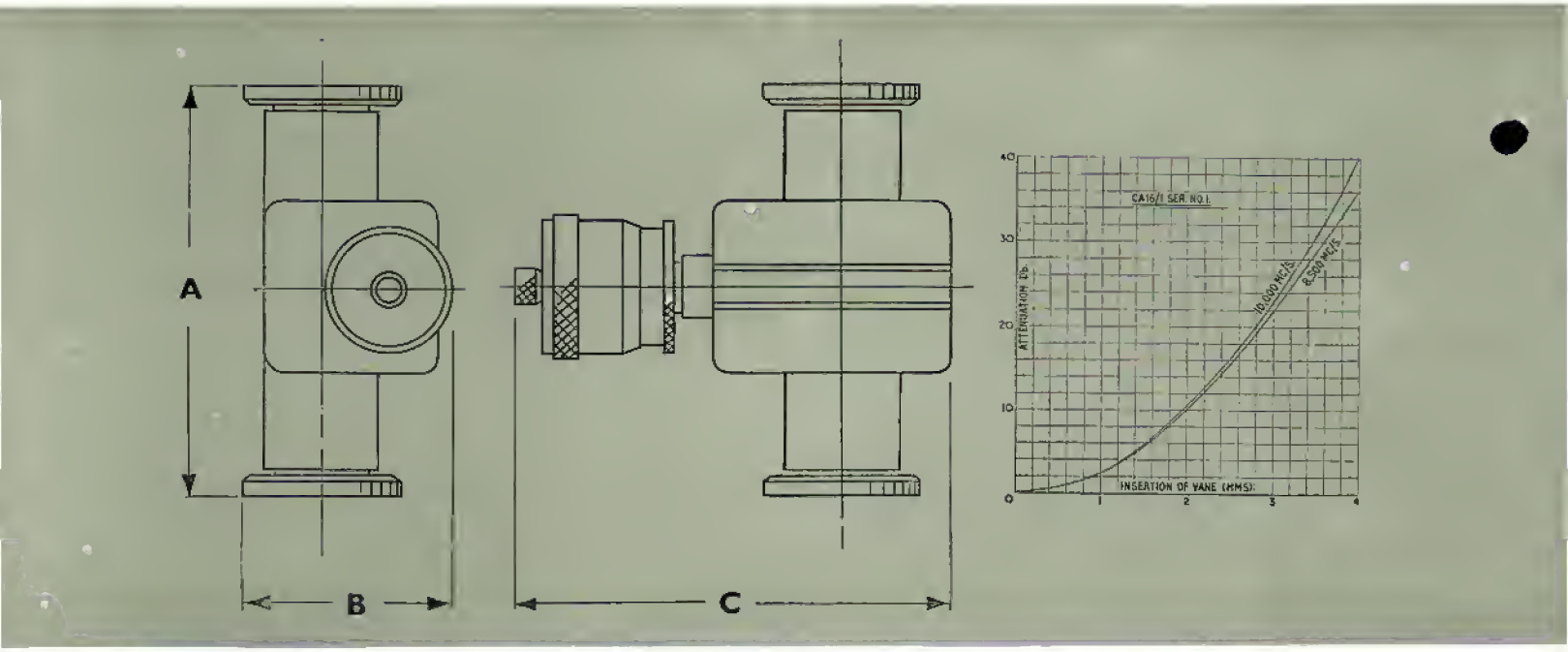
This type of instrument is designed on kinematic principles so as to minimise errors in measured attenuation due to undesired positional variance of the metallised glass attenuating element. This element is supported on two steel rods, fixed to a carriage which is moved by ...eans of a micrometer in a plane at right angles to the guide axis. The carriage is located by means of three steel balls which roll on hardened and ground steel tracks. Two springs are employed in the assembly, one to hold the carriage firmly to its tracks and the other to hold it in contact with the micrometer. The arrangement of the springs is such that forces are symmetrically distributed about the points of contact. By this method, backlash in the movement has been reduced to a value considerably less than the reading accuracy of the micrometer, which is 10^{-4} cms.

The body of the instrument is machined from solid aluminium alloy and the operating mechanism is enclosed in a cast aluminium case, which is both dust-proof and strong.

The spring forces and the choice of materials for construction are such that the instrument may be subjected to accelerations of over 15G in any direction without the carriage coming away from its tracks or sustaining damage. Accelerations of up to about 30G can be tolerated without significant damage, so that calibration is retained under stringent conditions of use.

specifications

As normally supplied a metallised glass attenuator element is fitted and calibration figures are provided at four frequencies in the waveguide pass band from 0 to 40db. The elements are of exceptionally high performance, being designed and supplied by Decca Radar Limited to Ministry of Supply specifications covering frequency, sensitivity, V.S.W.R., stability, uniformity and mechanical strength.



Waveguide Size	18	16	15	14	12	10
Type No.	CA 18/1	CA 16/1	CA 15/1	CA 14/1	CA 12/1	
Reading Accuracy ...	10^{-4} cm.	10^{-4} cm.	10^{-4} cm.	10^{-4} cm.	10^{-4} cm.	DEVELOPMENT
Reset Accuracy	10^{-4} cm.	10^{-4} cm.	10^{-4} cm.	10^{-4} cm.	10^{-4} cm.	
Backlash	Less than 5 x 10-5	Less than 5 x 10-5	Less than 5 x 10-5	Less than 5 x 10-5	Less than 5 x 10-5	COMPLETED.
Type of Element Fitted ...	Type B 0-40 db	MW 146-0.40 db element or MW 141 -0.20 db element	Type C 0.40 db	metallized glass 0-40 db	metallized glass 0-40 db	
Calibration Accuracy ...	0.05 db absolute 0.02 db relative	0.05 db absolute 0.02 db relative	0.05 db absolute 0.02 db relative	0.05 db absolute 0.02 db relative	0.05 db absolute 0.02 db relative	AVAILABLE
Reset Accuracy at steepest part of calibration curve	0.02 db	0.02 db	0.02 db	0.02 db	0.02 db	SHORTLY.
Recommended Frequency range in kMc/s	12.0-17.5	8.0-10.5	7.0-10.0	5.50-8.00	3.95-5.80	
Input V.S.W.R. at worst	0.95: 1	0.95: 1	0.95: 1	0.95: 1	0.95: 1	
Radiation Leakage ...	More than 60 db down	More than 60 db down	More than 60 db down	More than 60 db down	More than 60 db down	
Dimensions: A ...	6" (152.4 mm.)	$6\frac{1}{4}$" (158.7 mm.)	9" (228.6 mm.)	$10\frac{1}{4}$" (260.3 mm.)	$14\frac{1}{2}$' (368.3 mm.)	
B ...	$2\frac{3}{4}$" (69.8 mm.)	3" (76.2 mm.)	$2\frac{7}{8}$" (73.02 mm.)	$3\frac{3}{4}$" (95.2 mm.)	4" (101.6 mm.)	
C ...	$6\frac{1}{2}$" (165.1 mm.)	$6\frac{1}{2}$" (165.1 mm.)	$6\frac{1}{2}$" (165.1 mm.)	$7\frac{1}{4}$" (184.15 mm.)	$8\frac{1}{2}$" (215.9 mm.)	
Weight	2lb. 10oz. (1.19 kg.)	3lb. (1.36 kg.)	$3\frac{1}{4}$lbs.	$5\frac{1}{2}$lbs. 2.55 kg.	$7\frac{1}{2}$lbs. (3.4 kg.)	
Flanges	Z830030 both ends	Z830004 both ends	Z830034 both ends	Z830038 both ends	Z830042 both ends	

Flanges : Details of all flanges can be found on flange data sheet. Alternative flanges can be supplied to order.

Finish : Waveguide is duralumin, black anodised. The casing is grey hammer enamelled.

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Gunnels Wood Road, Stevenage, Herts. Tel. : Stevenage 981. Grams and Cables : Sandelect, Stevenage. Telex : 82159 Sanders Stev.
London Office : 49 Conduit Street, London, W.1. Telephone : Regent 3534. Telegrams and Cables : Santronic, London
German Associate Company : Sanders Electronics G.M.B.H., Eysseneckstrasse 19, Frankfurt-am-Main. Telephone : Frankfurt 593368
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Sanders

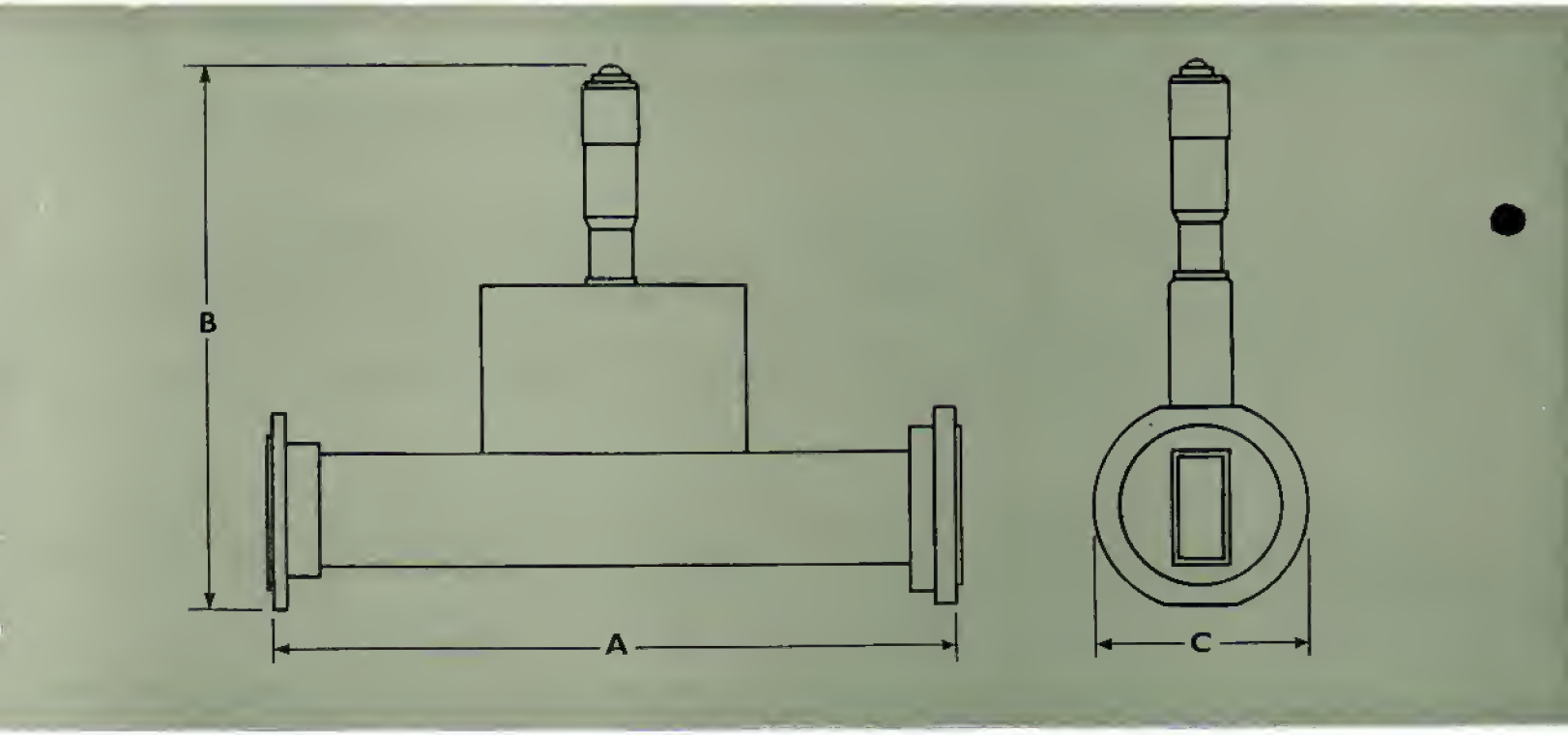
grade II calibrated attenuators

CA 16/2

A micrometer is coupled via an antibacklash system and two rods extending through the narrow wall of a waveguide to a metallised glass vane in the guide. This provides a mechanical discrimination of the position of the glass vane to better than 0.1 db over the range 0 to 40 db.

The attenuator is normally supplied with a 40 db element fitted and calibration figures are provided at four frequencies in 2 db steps from 0 to 20 db and 4 db steps from 20 to 40 db. The accuracy of this calibration is 0.1 db from 0 to 20 and 0.25 db from 20 to 40 db.

specifications



Wave Guide Size	Type No.	Frequency Coverage in kMc/s	Attenuation range in db	Calibration Frequencies in kMc/s	Reset Accuracy in db	V.S.W.R. mid band	Insertion loss in db	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges
18	CA18/2	12.0-17.5	0-40	12.5, 14, 15.5, 17.0	0.1	better than 0.95: 1	0.1 db	5½" 140 mm.	4" 101.6 mm.	1 5/16" 33.3 mm.	10oz. 283.5 grm.	Z830030 and Z830029
16	CA16/2	8.0-10.5	0-40	8.5, 9.0 9.5, 10.0	0.1	,,	0.1 db	6" 152.4 mm.	5" 127 mm.	1⅞" 48 mm.	15oz. 425 grm.	Z830004 and Z830003
15	CA15/2	7.0-10.0	0-40	7.5 8.2 8.8 9.5	0.1	,,	0.1 db	9" 228.6 mm.	5" 127 mm.	1⅞" 48 mm.	1¾lb. 794 grm.	Z830034 and Z830033
14	CA14/2	5.50-8.00	0-40	5.85 6.50 7.00, 7.50	0.1	,,	0.1 db	10" 254 mm.	5¾" 146 mm.	3⅛" 79.4 mm.	2¾lb. 1.25 kgs.	Z830038 and Z830037
12	CA12/2	3.95-5.80	0-40	4.00, 4.50 5.00, 5.50	0.1	,,	0.1 db	14½" 268.3 mm.	7½" 190.5 mm.	3⅝" 92 mm.	5lb. 2.27 kgs.	Z830042 and Z830041
10	CA10/2	2.60-3.60	0-40	2.7, 3.00 3.3, 3.60	0.1	,,	0.1 db	17" 431.8 mm.	9" 229 mm.	3¼" 82.5 mm.	7½lb. 3.4 kgs.	Z830010 and Z830009

Flanges : Details of flanges fitted are shown on flange data sheet.
Finish : Grade I B.S.I. Instrument Finish.

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Gunnels Wood Road, Stevenage, Herts. Tel. : Stevenage 981. Grams and Cables : Sandelect, Stevenage. Telex : 82159 Sanders Stev.
London Office : 49 Conduit Street, London, W.1. Telephone : Regent 3534. Telegrams and Cables : Santronic, London
German Associate Company : Sanders Electronics G.M.B.H., Esseneckstrasse 19, Frankfurt-am-Main. Telephone : Frankfurt 593368
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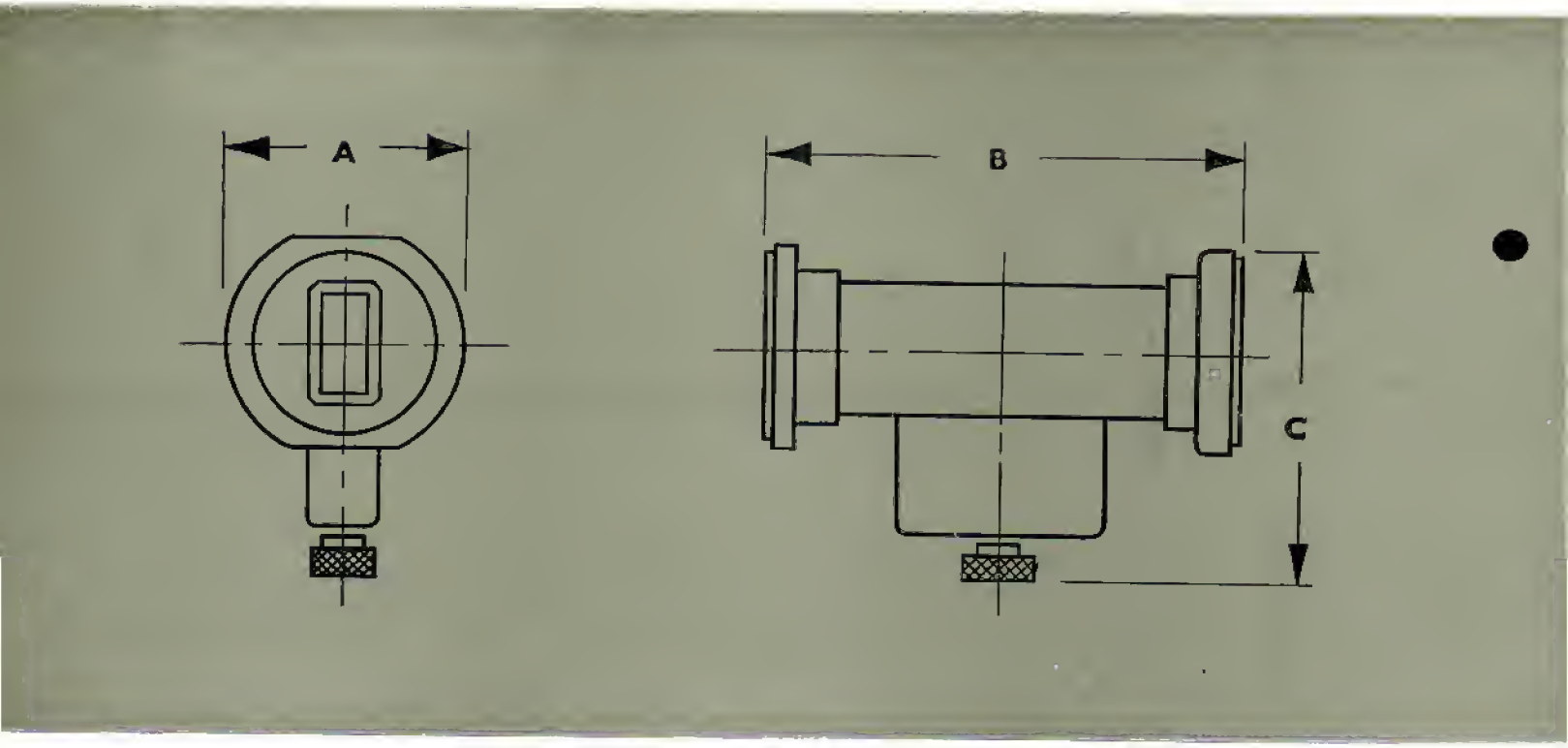
Sanders

variable attenuators

VA 16

An essential ancillary component in a microwave measuring system is the pre-set or level setting attenuator. To produce an inexpensive instrument the moving parts have been reduced to their simplest form, thus achieving economy in production without sacrificing any essential feature. The vane is made of carbon coated Paxolin, vacuum-impregnated to exclude moisture; this process eliminates the main objections to the use of the material for attenuators. An approximate indication of attenuation is given by a moving pointer coupled to the attenuator insertion control. A 20 db element is normally supplied, but other values can be fitted if requested.

specifications



Wave Guide No.	Type No.	Attenuation Range	Input V.S.W.R.	DIMENSIONS A	B	C	Weight	Flanges
WG 16	VA 16	0-20db	better than 0.9: 1	2" 50.8mm.	4" 101.6mm.	3" 76.2mm.	10oz. (283.5grm.)	Z830003 one end Z830004 the other

Finish: Grade I Instrument Finish.
Flanges: Alternative flanges supplied to order. Details on flange data sheet.

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German Associate Company : Sanders Electronics G.M.B.H., Eyssenecksstrasse 19, Frankfurt-am-Main. Telephone : Frankfurt 593368
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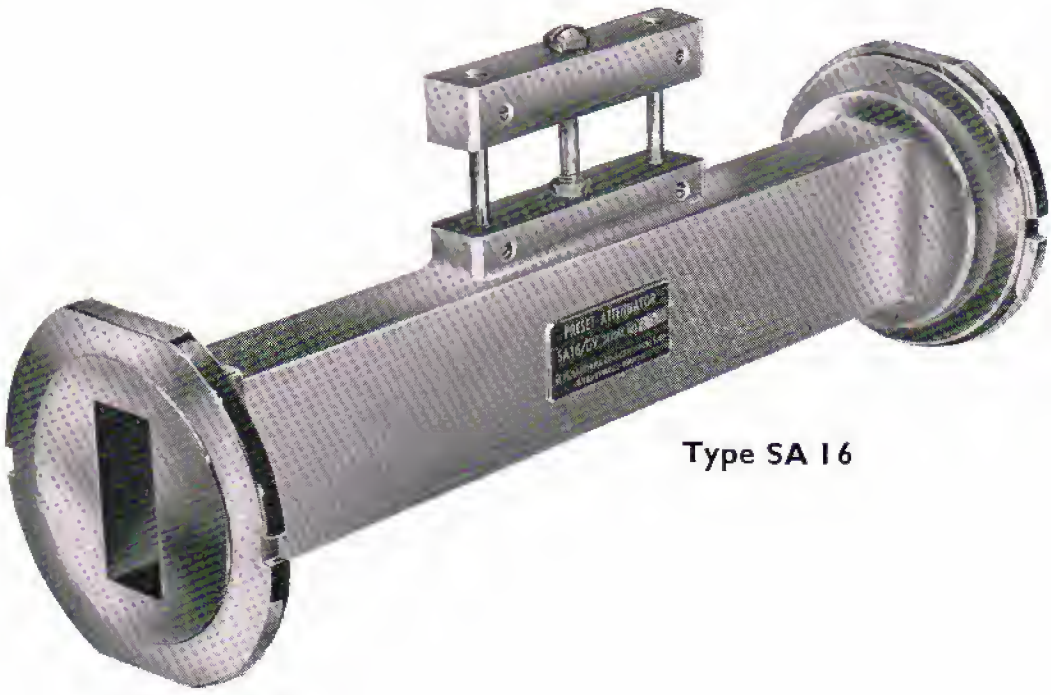
pre-set attenuators



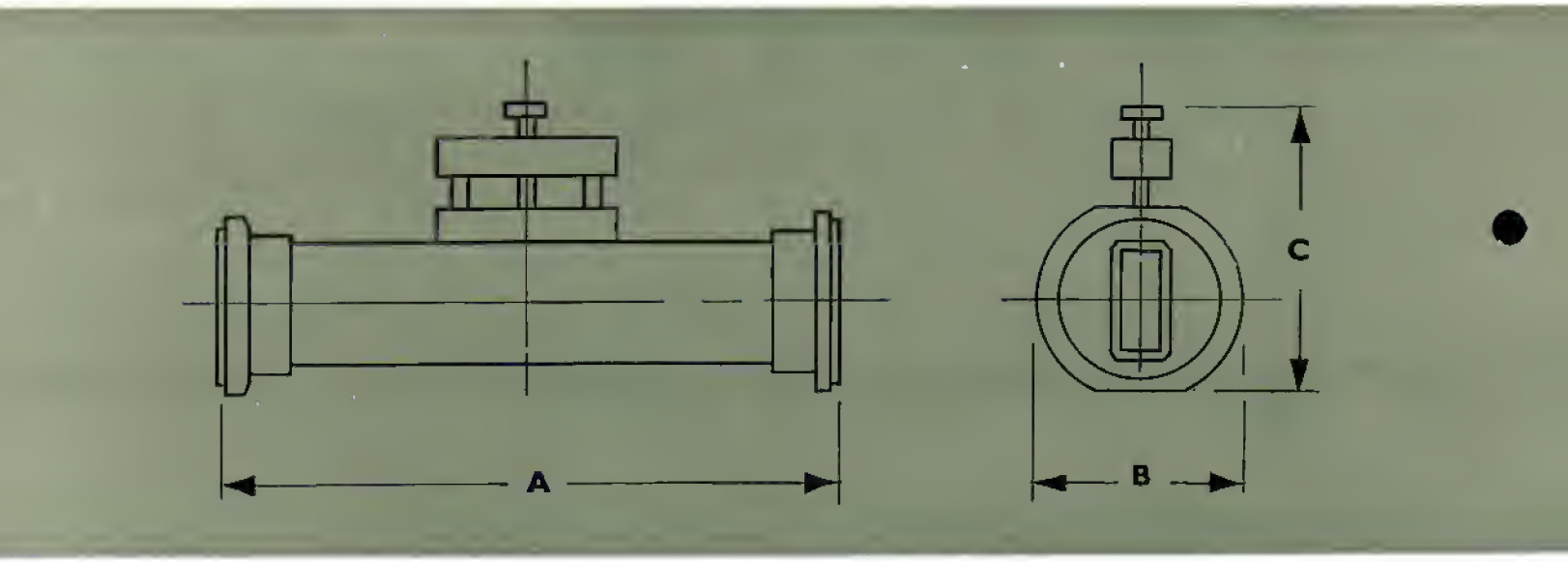
Type SA 16

These devices are capable of being set to any desired value of attenuation between limits which are specified by the type of Decca glass vane elements fitted.

An accurately manufactured mechanical assembly ensures stability with time, once the attenuator has been set to the desired value. Two locking screws enable the desired value of attenuation to be maintained during handling.

The attenuator is well matched and may, therefore, be used in a variety of ways, e.g. as a pre-set pad, as a fixed reference sub-standard of attenuation, or by the addition of a short circuit termination at one end, as a reference mis-match unit.

specifications



Wave Guide Size	Type No.	Recommended Frequency Range kMc/s	Attenuation Range (db)	Input V.S.W.R.	DIMENSIONS A	B	C	Weight	Flanges
WG 18	SA 18	12.0-17.5	0.1-40	0.95: 1	5″ 127mm.	1 5/16″ 33.3mm.	1 7/8″ 48mm.	7oz. 198grms.	Z830030 one end Z830029 the other
WG 16	SA 16	8.0-10.5	0.1-20	0.95: 1	6″	2″	2 1/4″	11oz.	Z830003 one end
			0.1-40	0.95: 1	152.4mm.	50.8mm.	57.1mm.	312grms.	Z830004 the other
WG 15	SA 15	7.5-10.0	0.1-40	0.95: 1	7 3/4″ 197mm.	1 7/8″ 48mm.	2 3/4″ 70mm.	1lb. 1oz. 482grms.	Z830034 one end Z830033 the other
WG 14	SA 14	5.50-8.00	0.1-40	0.95: 1	10″ 254mm.	3 1/8″ 79.38mm.	4″ 101.6mm.	1lb. 8oz. 680grms.	Z830037 one end Z830038 the other
WG 12	SA 12	3.95-5.80	0.1-40	0.95: 1	14 1/2″ 368mm.	3 5/8″ 92mm.	4 5/8″ 118mm.	3lb. 14oz. 1756grms.	Z830041 one end Z830042 the other
WG 10	SA 10	2.60-3.60	0.1-40	0.95: 1	17″ 431.8mm.	3 1/4″ 82.5mm.	7″ approx. 177.8mm.	8lb. approx. 3.6Kg.	Z830009 one end Z830010 the other

Details of flanges fitted shown on Flange data sheet.
Alternative British or American Flanges fitted to order.
Finish : Grade 1 Instrument Finish.
General Characteristics of Decca Attenuating Elements.

Insertion Loss: Approximately 0.1 db.

Maximum power dissipation: 1 watt.

Temperature coefficient of attenuation: Negligible.

Long Term stability: Completely stable under normal laboratory conditions.

Performance unaffected by exposure for 18 hours at 57°C. 95% relative humidity, or by heating at 80°C, zero relative humidity, for short periods.

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London Office : 49 Conduit Street, London, W.1. Telephone : Regent 3534. Telegrams and Cables : Santronic, London
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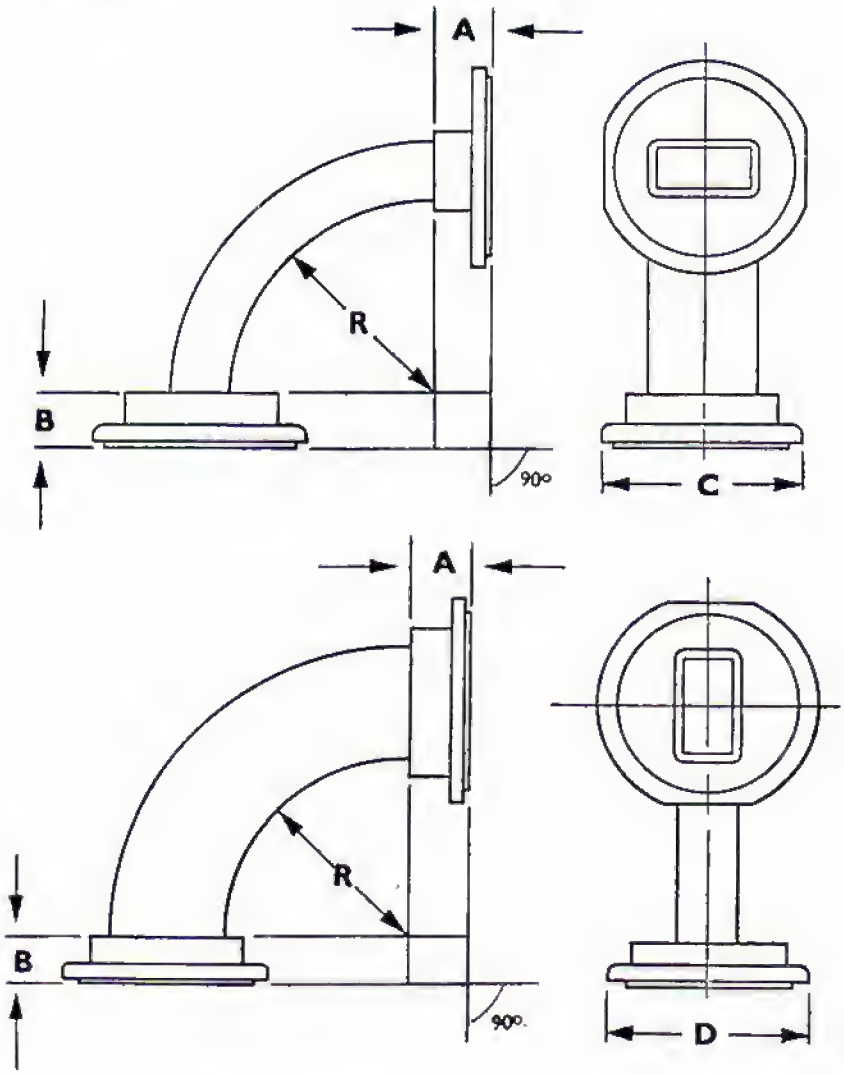
E & H plane bends

EB 16

HB 16

These E- and H-Plane waveguide bends are widely used where 90° angle is required with negligible reflection of the microwave signal. The VSWR of all bends is 0.95:1 maximum. The bends are fabricated from precision brass (copper on request) waveguide and the inner cross-sectional dimensions are maintained within the standard waveguide tolerances. Other radii and materials are available to special order.

specifications



Wave Guide Size	Bend	Type No.	V.S.W.R.	DIMENSIONS A	B	R	C	D	Weight	Flanges
WG 18	E Plane	EB18	0.95: 1	$\frac{3}{8}$" 9.5mm.	$\frac{7}{16}$" 11.1mm.	$1\frac{7}{16}$" 36.5mm.	$1\frac{5}{16}$" 33.3mm.	$1\frac{5}{16}$" 33.3mm.	4oz. 113.4grm.	Z830030 and Z830029
	H Plane	HB18	0.95: 1			1" 25.4mm.				
WG 16	E Plane	EB16	0.95: 1	$\frac{1}{2}$" 12.7mm.	$\frac{1}{2}$" 12.7mm.	$1\frac{3}{4}$" 44.5mm.	$1\frac{7}{8}$" 48.0mm.	2" 50.8mm.	$7\frac{1}{2}$oz. 212.6grm.	Z830004 and Z83003
	H Plane	HB16	0.95: 1			$1\frac{1}{2}$" 38.1mm.				
WG 15	E Plane	EB15	0.95: 1	$\frac{9}{16}$" 14.3mm.	$\frac{3}{4}$" 19.0mm.	$1\frac{7}{8}$" 47.6mm.	$1\frac{7}{8}$" 48.0mm.	$1\frac{7}{8}$" 48.0mm.	12oz. 340.2grm.	Z830034 and Z830033
	H Plane	HB15	0.95: 1			$1\frac{9}{16}$" 39.7mm.				
WG 14	E Plane	EB14	0.95: 1	$\frac{5}{8}$" 15.9mm.	1" 25.4mm.	$1\frac{7}{8}$" 47.6mm.	$3\frac{1}{8}$" 79.4mm.	$3\frac{1}{8}$" 79.4mm.	$1\frac{1}{2}$lb. 680.4grm.	Z830037 and Z830038
	H Plane	HB14	0.95: 1			$3\frac{1}{4}$" 82.6mm.				
WG 12	E Plane	EB12	0.95: 1	$\frac{3}{4}$" 19.0mm.	$1\frac{3}{16}$" 30.2mm.	$3\frac{1}{2}$" 88.9mm.	$3\frac{5}{8}$" 92.0mm.	$3\frac{5}{8}$" 92.0mm.	3lb. 1.36kg.	Z830041 and Z830042
	H Plane	HB12	0.95: 1			4" 101.6mm.				

Finish: Grade I Instrument Finish.
Flanges: Alternative flanges fitted to order.
Details shown on flange data sheet.

Sanders

90° waveguide twists

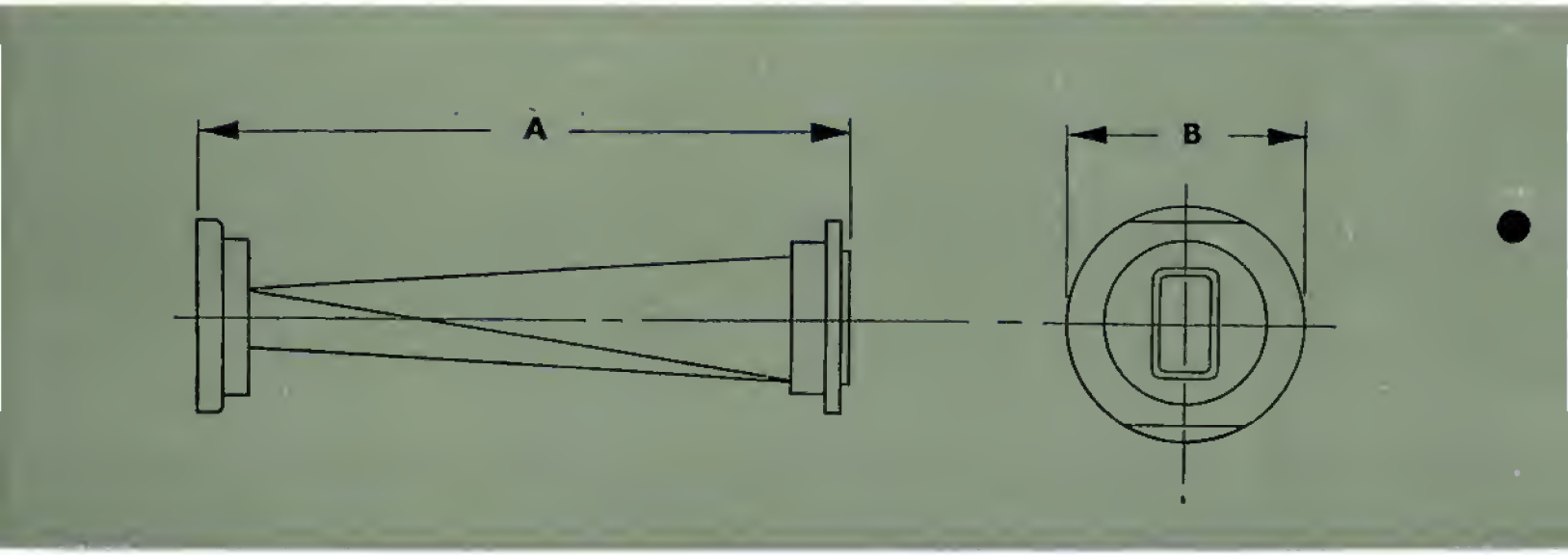
T 16

These components are useful ancillaries in the microwave laboratory.

Great care is taken in forming these 90° twists to ensure that the angular rate of change is constant, and that the cross section throughout the length is maintained closely rectangular and to nominal dimensions. These precautions ensure that the disturbance introduced by the rotation of the plane of polarisation is reduced to a minimum.

Alternative angles of twist, and overall length, available to special order.

specifications



Wave Guide Size	Type No.	Frequency Range in kMc/s	V.S.W.R.	DIMENSIONS A	DIMENSIONS B	Weight	Flanges
WG 18	T 18	12.4-18.0	Better than 0.97: 1	5″ (127mm.)	1.2″ (28mm.)	4oz. 113.4grm.	Z830030 Z830029
WG 16	T 16	8.2-12.0	Better than 0.97: 1	6″ (152.4mm.)	2″ (50.8mm.)	9oz. 225grm.	Z830003 Z830004
WG 15	T 15	7.50-10.0	Better than 0.97: 1	7½″ (190.5mm.)	1¾″ (46.6mm.)	14oz. 397grm.	Z830034 Z830033
WG 14	T 14	5.0-8.0	Better than 0.97: 1	12″ (304.8mm.)	3⅛″ (79.4mm.)	1¾lb. 794grm.	Z830037 Z830038
WG 12	T 12	3.95-5.85	Better than 0.97: 1	15.5″ (394mm.)	3⅝″ (92mm.)	2¾lb. 1.25kg.	Z830042 Z830041

Finish: Grade 1 Instrument Finish.

Flanges: Alternative Flanges fitted to order.
Details of Flanges shown on Flange Data Sheet.

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Gunnels Wood Road, Stevenage, Herts. Tel. Stevenage 981 (6 lines). London Office: 49 Conduit Street, London, W.1. Tel. Regent 3534

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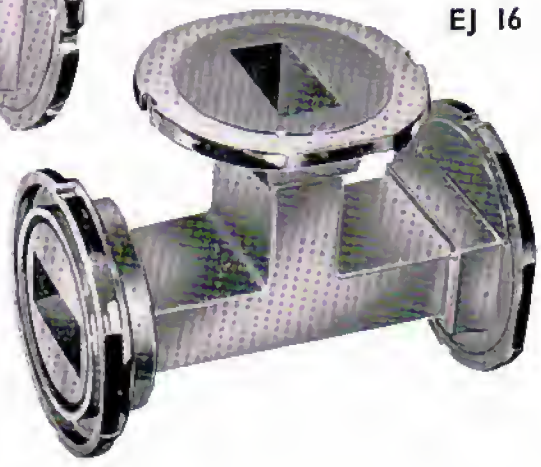
E & H junctions

HJ 16

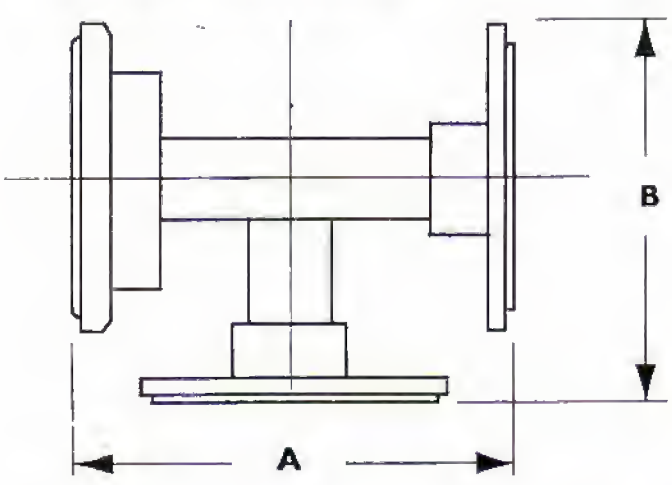
EJ 16

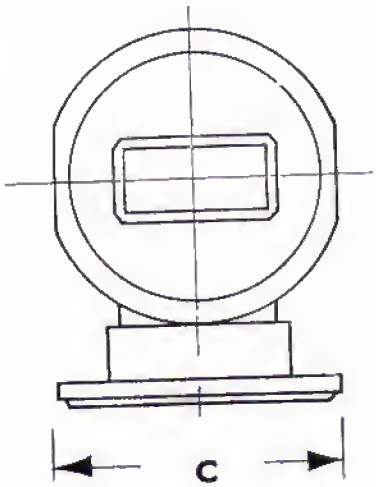


These waveguide junctions may be used for making connections in microwave circuits corresponding to Series and Shunt Connections at low frequencies.

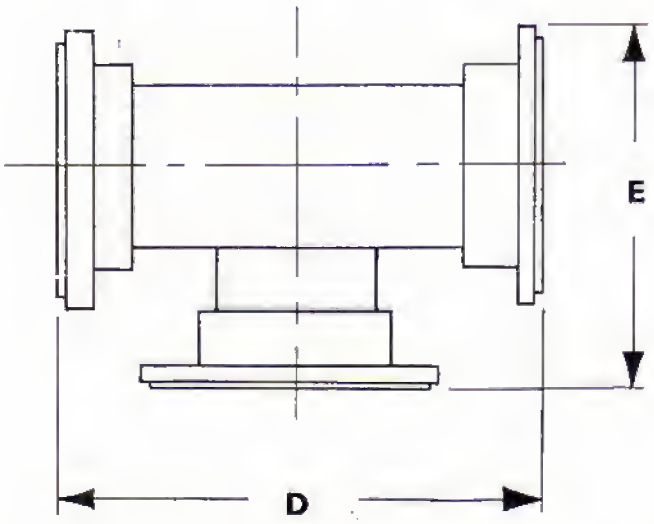
The branch series or shunt waveguide arm, is held perpendicular to the main waveguide to close tolerances to permit use as a power divider.

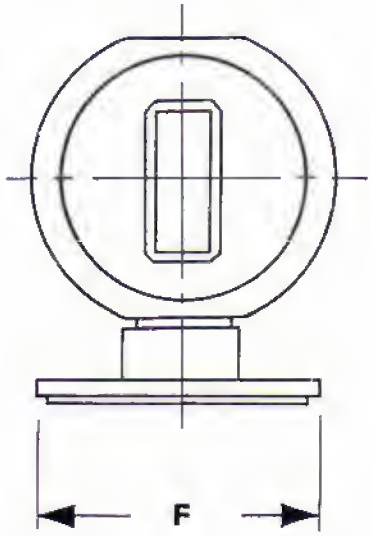
specifications





E plane junction





H plane junction

Guide Wave Size	Junctions	Type No.	DIMENSIONS A	B	C	D	E	F	Weight	Flanges
WG 18	E Plane	EJ18	$2\frac{9}{16}$" 65mm.	$1\frac{3}{4}$" 44.4mm.	$1\frac{5}{16}$" 33.3mm.				5oz. 142.0grm.	Z830030 and Z830029 through arms.
	H Plane	HJ18				$2\frac{9}{16}$" 65mm.	2" 50.8mm.	$1\frac{5}{16}$" 33.3mm.	5oz. 142.0grm.	Z830030 perpendicular arm.
WG 16	E Plane	EJ16	$2\frac{1}{2}$" 63.5mm.	$2\frac{1}{4}$" 57.1mm.	$1\frac{7}{8}$" 47.6mm.				$9\frac{1}{2}$oz. 269grm.	Z830004 and Z830003 through arms.
	H Plane	HJ16				3" 76.2mm.	$2\frac{1}{2}$" 63.5mm.	2" 50.8mm.	$9\frac{1}{2}$oz. 269grm.	Z830004 perpendicular arm.
WG 15	E Plane	EJ15	$3\frac{3}{4}$" 95.25mm.	3" 76.2mm.	$1\frac{7}{8}$" 47.6mm.				14oz. 396.9mm.	Z830034 and Z830033 through arms.
	H Plane	HJ15				$3\frac{3}{4}$" 95.25mm.	3" 76.2mm.	$1\frac{7}{8}$" 47.6mm.	14oz. 396.9mm.	Z830034 perpendicular arm.
WG 14	E Plane	EJ14	$4\frac{1}{2}$" 114.3mm.	$4\frac{1}{8}$" 104.7mm.	$3\frac{1}{8}$" 79.5mm.				2lb. 4oz. 1.02Kg.	Z830037 and Z830038 through arms.
	H Plane	HJ14				$4\frac{1}{2}$" 114.3mm.	$4\frac{1}{8}$" 104.7mm.	$3\frac{1}{8}$" 79.5mm.	2lb. 4oz. 1.02Kg.	Z830037 perpendicular arm.
WG 12	E Plane	EJ12	6" 152.4mm.	$4\frac{13}{16}$" 122.2mm.	$3\frac{5}{8}$" 92.0mm.				4lb. 1.8Kg.	Z830042 and Z830041 through arms.
	H Plane	HJ12				6" 152.4mm.	$5\frac{5}{16}$" 135mm.	$3\frac{5}{8}$" 92.0mm.	4lb. 1.8Kg.	Z830042 on perpendicular arm.
WG 10	E Plane	EJ10	9" 228.6mm.	$7\frac{3}{4}$" 196.85mm.	$3\frac{1}{4}$" 82.5mm.				7lb. approx. 3.18Kg.	Z830009 and Z830010 through arms.
	H Plane	HJ10				9" 228.6mm.	$8\frac{1}{2}$" 215.9mm.	$3\frac{1}{4}$" 82.5mm.	7lb. approx. 3.18Kg.	Z830010 on perpendicular arms.

Finish: Grade I Instrument Finish.

Flanges: Alternative flanges fitted to order. Details shown on flange data sheet.

ridge waveguide components

FOR COMMERCIAL AIRBORNE WEATHER RADAR

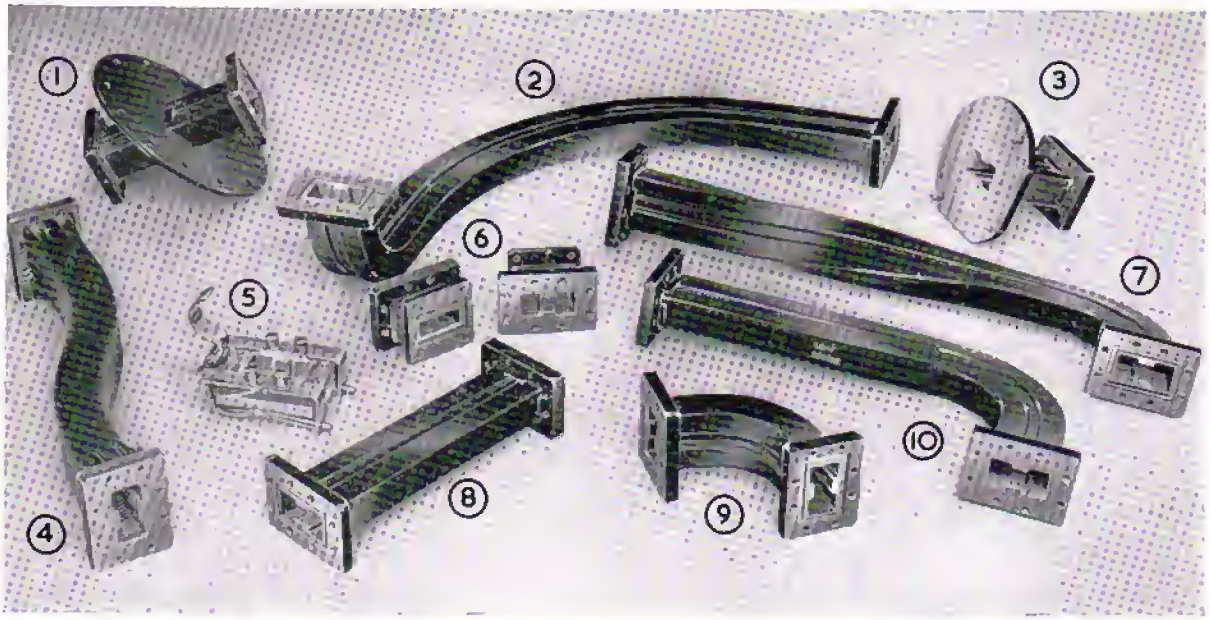
Due to existing differences of opinion concerning the optimum frequency for airborne weather penetration radar systems, leading manufacturers of such equipment have selected different operating frequencies for their designs, viz: 5.7 cms. ('C' Band) or 3.2 cms. ('X' Band).

An aircraft waveguide run from radio rack to radome should therefore be able to operate at either wavelength without degrading the performance of the system, particularly where the run is to be installed permanently. To meet these requirements Airtron Inc., Linden, New Jersey, U.S.A. developed a double ridge waveguide of extremely wide frequency range complying with the specifications of characteristic No. 529 of Aeronautical Radio, Inc. (ARINC). Under our licence agreement with Airtron Inc., we are now manufacturing a full range of these components at our Stevenage, Herts., works.

Among them are Pressurised Bulkhead Assemblies, Straight Sections, Twists, Transitions, 90° and 45° 'E' and 'H' Plane Bends, Flexible Ridgeguide, Quick Disconnects, Plain and Gasket Flanges and R.F. Pressure Gaskets. Transitions and R.T. Unit Adapters are available to suit Bendix RDR-1 or RCA AVQ-10 etc. Weather Radar as required. The Ridgeguide Bends are based on 2.214" and 7" radii measured to the centre of the waveguide, and the 90° Twists are incorporated over a length of 8". The Pressurised Bulkheads are tested to 30 p.s.i. and can therefore fully meet Air Regulation Board requirements in this respect. By using these components an aircraft waveguide installation becomes fully adaptable to either 'C' Band of 'X' Band radars, and as a result commercial aircraft so equipped are useable for whichever radar the customer may choose.

Substantial savings in weight and space are also achieved with a ridge waveguide run as this is only slightly larger than 1" × ½" O/D guide size used in normal 'X' Band operation. The design of such double ridge waveguide components can thus be easily adapted to suit any aircraft configuration, and we invite your enquiries accordingly. Our Engineers will co-operate fully in advising such layouts to achieve both mechanical and electrical optimum performance.

specifications



Material: Rigid Ridge Guide—aluminium. Flexible Ridge Guide —brass.

Finish: Aluminium-Alocrom DTD.900F (RD.4091), zinc chromate primer, and matt stove enamel DTD.235, black, or signal red tint 537.

Temperature: Flexible Ridge Waveguides are jacketted in synthetic rubber to give good flexibility at —55°C. and are impervous to oils, brake fluids and other contaminants encountered in the average installation. Gaskets—similar to above, these provide excellent R.F. and pressure tightness with low V.S.W.R., flange connections at low temperature.

Note: When isolation of a pressurised section of the waveguide system is required or where it is desirable to isolate exterior waveguide exposed to the effects of moisture or interior condensation, Mica R.F. windows of low V.S.W.R. may be incorporated. Details on application.

KEY

1. Typical Pressure Bulkhead Assy.
2. Typical 2.214" & 7" radii bend.
3. R.C.A. A.V.Q. -10 Adaptor.
4. Flexible Ridgeguide Unit.
5. Quick Disconnect Assy.
6. Bendix RDR-1 Transition X-Band Double Ridge.
7. Combined 90° Twist & 2.214" Radius Bend.
8. Typical Rigid Ridgeguide Assy.
9. Standard 90° 'E' Plane Elbow.
10. Typical 2.214" Radius 'H' Plane Bend.

PERFORMANCE

Frequency Mc/s.	Rigid			Flexible				
	V.S.W.R. Max.	Attn. db/ft. max.	Power Capacity K.W.	V.S.W.R. min.	Attn. db/ft. max.	Power Capacity KW.	Minimum Bend Radii measured to centre line of waveguide E Plane	H Plane
5,400 (C Band)	.95	.05	750	.92	.10	500	3.25" Radius	4.75" Radius
9,300 (X Band)	.95	.05	600	.90	.10	400		

Frequency range designed for operation from 5,200 to 9,600 mcs.
Weights of specific assemblies will be supplied on request.

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Gunnels Wood Road, Stevenage, Herts. Tel. : Stevenage 981. Grams and Cables : Sandelect, Stevenage. Telex : 82159 Sanders Stev.
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Sanders

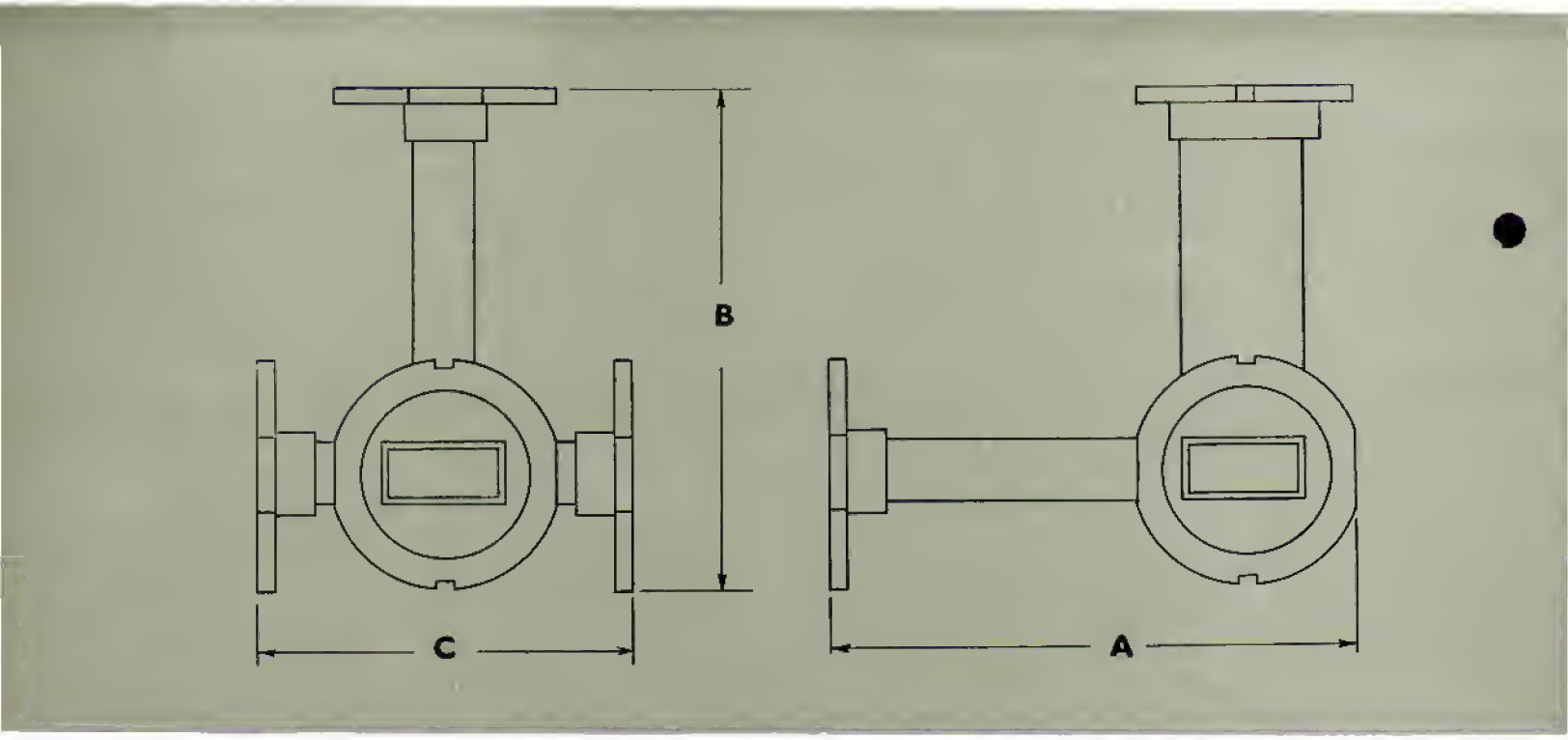
magic tees

MGT 16

The magic tee in rectangular waveguide consists of an H plane T and an E plane T formed at the same point in a waveguide by means of four waveguide sections accurately brazed together so that the E and H planes of the guides are perpendicular. Each guide is of conventional proportions and only dominant waves with their electric vector perpendicular to the broad walls can be supported. Because of the electrical symmetry involved, opposite arms of the junction are isolated from each other by about 40 db attenuation. The junction is matched by an iris and post system over an 8% bandwidth centred around mid band for each waveguide size to a VSWR of better than 0.70 : 1.

Magic Tees are used extensively in connection with microwave receivers, and other measurements involving bridge circuits, impedance comparisons, VSWR measurements, etc.

specifications



Wave Guide Size	Type No.	Bandwidth (midband)	VSWR E arm	VSWR H arm	VSWR Through arm	Isolation between E & H arms	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges
18	MGT 18	8%	0.70 : 1	0.87: 1	0.83 : 1	greater than 40 db	3½" 89 mm.	3" 76.2 mm.	2½" 63.5 mm.	7oz. 198 grm.	Z830030
16	MGT 16	8%	0.70 : 1	0.87: 1	0.83 : 1	greater than 40 db	4¼" 108 mm.	4" 101.6 mm.	3" 76.2 mm.	14oz. 397 grm.	Z830004
15	MGT 15	8%	0.70 : 1	0.87: 1	0.83 : 1	greater than 40 db	5¼" 133.3 mm.	4¾" 120.6 mm.	3¾" 95.25 mm.	24oz. 680 grm.	Z830034
14	MGT 14	Under Development — Available shortly.									
12	MGT 12										
10	MGT 10										

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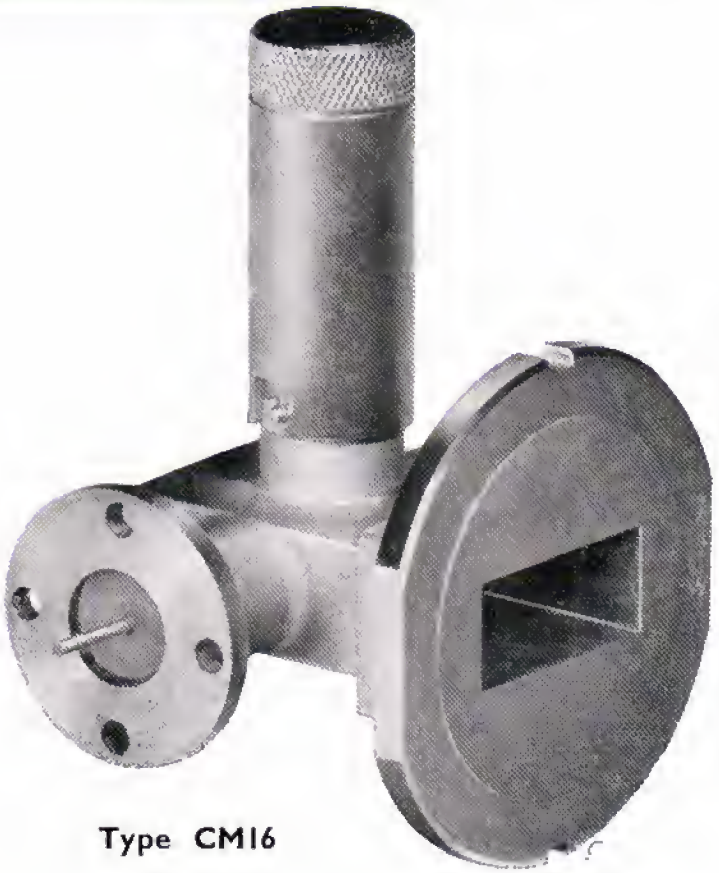
crystal mixers



Type CM16

NOTE:

Fixed tuned in WG16

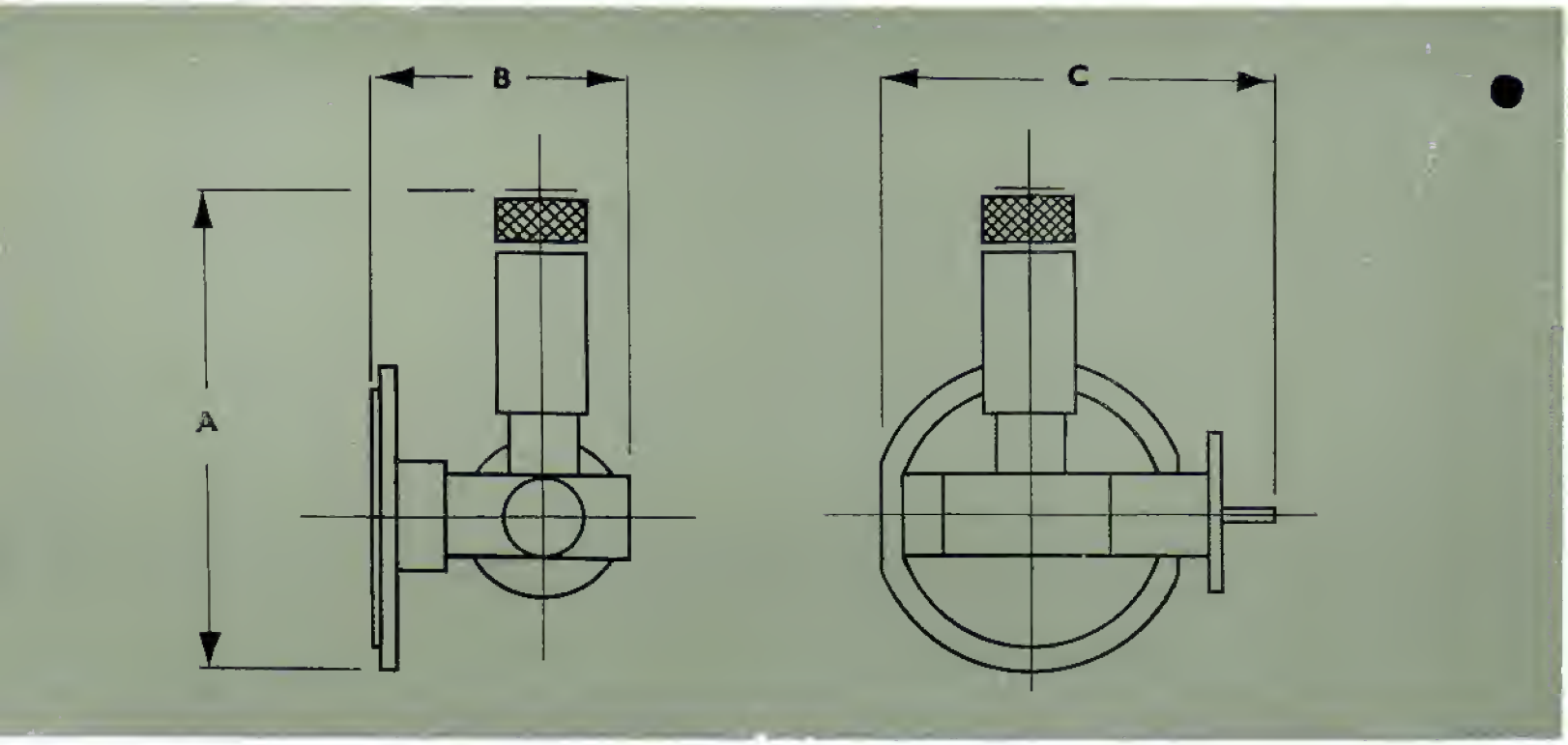
Tuneable by variable short circuit in all other waveguide sizes

These mixers are broad band designs for use with high sensitivity microwave receivers. For use in this type of work they have a soldering pin for the I.F. output and flange to enable them to be bolted directly to a head amplifier chassis close to the input stage. Coaxial crystals are used, the types being CV2154 and CV2155 for all waveguide sizes, up to WG 16 and 1N26 for the waveguide sizes above this. With the exception of waveguide size 16 which is a fixed tuned mount these mounts are tuneable by a variable short circuit in the waveguide. As a typical example of performance the waveguide 16 mount has a V.S.W.R. of better than 0.5:1 for all values of crystal current up to 0.5mA; the optimum V.S.W.R. is 0.9:1 at 9,500 Mc/s with a Crystal current of 0.5mA. Similar performances at other frequencies are obtained with other mounts.

In addition to their functions as mixers these mounts will also operate successfully as a detector with a good V.S.W.R. One of the characteristics required of them as a mixer is that they should have a very low shunt capacity. This property enables them to be used as a high sensitivity detector for pulse work. A very wide video frequency band width is possible in this type of system. If a unit is used in conjunction with a cathode follower, band widths of over 20 Mc/s are readily obtained. Typical performance figures for a waveguide 16 mixer are 0.2 millivolts per microwatt with

specifications

a band width of 12Mc/s using a cathode follower with an output impedance of 70 ohms feeding a coaxial line terminated in 70 ohms. It is worth noting that under these circumstances the coaxial line may be matched at both ends, and band width is then independent of its length.
It will be seen therefore that these components are useful both as a broad band mixers and as broad band high sensitivity detectors in crystal video receivers. They can also be used in high speed pulse measuring circuits, for accurate square law detection (in which the associated circuits are important) and for general purpose laboratory use of power monitoring.



Wave Guide Size	Type No.	Crystal Used	Frequency Coverage in kMc/s	V.S.W.R.	Dimensions A	B	C	Weight	Flanges
WG 18	CM 18	IN26	12.0–18.0	About 0.5: 1	2½" 63.5 mm.	4⅝"	1½" 38.1 mm.	5 oz. 142 gm.	Z830030
WG 16	CM 16	CV2154 CV2155	8.5–12	About 0.5: 1	2⅞" 73 mm.	1⅝" 41.3 mm.	2¼" 57.1 mm.	6 oz. 170.1 gm.	Z830004
WG 15	CM 15	CV2154 CV2155	7.0–10	About 0.5: 1	3"	6"	2⅜"	1 lb. approx. 454 grm.	Z830034
WG 14	CM 14	As above	5.85–8.2	About 0.5: 1	3¾" (approx)	9" (approx)	3⅛" (approx)	1½ lb. (approx)	Z830038
WG 12	CM 12	As above	3.95–5.85	About 0.5: 1	3 13/16" (approx)	10 5/16" (approx)	3 1/16" (approx)	2½ lb. (approx)	Z830042

Flanges: Details of all flanges fitted are shown on flange data sheet
Alternative British or American flanges fitted to order
Finish: Grade 1 Instrument Finish
Crystals: These are not supplied with the mixer unless requested

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crystal detectors

CD 16

These components provide a fully screened coaxial connector output from a bar post transition to a coaxial crystal. This crystal is the CV2154 or CV2155 for waveguide sizes WG 10 to WG 16 and the IN26 for waveguide sizes above this.

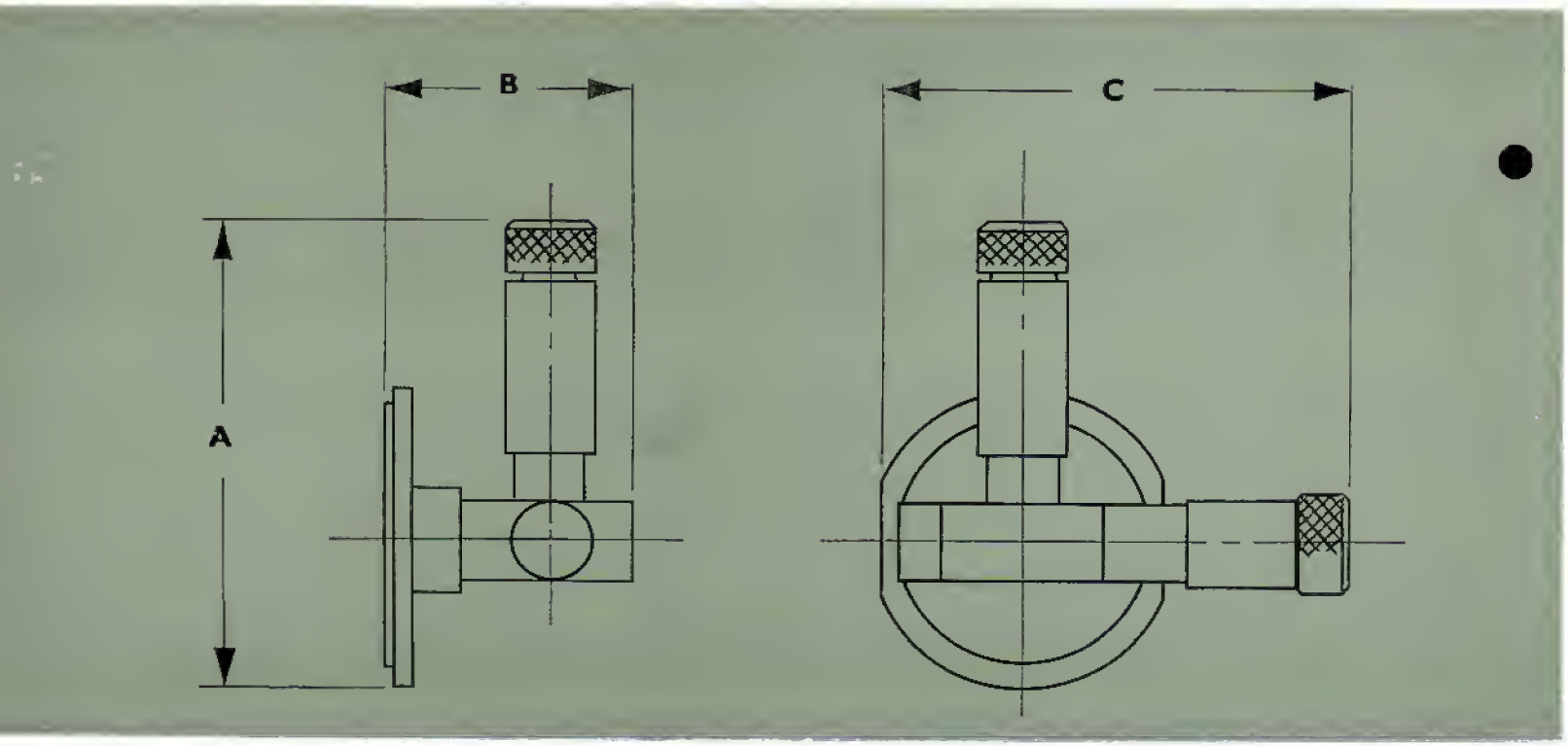
The detector is a modification of the waveguide crystal mixer Type CM, in which general properties of the waveguide to co-axial transistion have been retained but the flange and solder tag have been replaced by a fixing for coaxial cable.

In the case of WG 16 the mount is fixed tuned but for all other waveguide sizes the system is tuneable by a moveable short circuit.

The crystals used with this component have a video impedance at very low level which is approximately constant with a value between 10,000 and 20,000 ohms. When working into this value of impedance, therefore, the crystal will achieve its maximum efficiency as a converter of R.F. energy to DC energy. Due to the high crystal video impedance at low level, the detector is unsuitable for use with short pulses, as the capacity of the coaxial cable, together with the high load impedance required for good efficiency, would severely restrict the video frequency pass band. The detector may be successfully operated at

higher R.F. power levels into a meter or galvonometer. It is particularly useful, however, when feeding into a high gain amplifier having an input impedance of about 10,000 to 20,000 ohms. Under these conditions the screening provided by the coaxial cable, together with the high power transfer efficiency achieved by matching the crystals into its optimum load, makes it possible to obtain a very high sensitivity of R.F. detection. In addition, the crystal rectification is quite accurately square law at low levels.

This component is not recommended for use as a crystal mixer, except in those cases where the Type CM and a head amplifier cannot satisfactorily be operated.



SPECIFICATIONS

Wave Guide Size	Type No.	Crystal Used	Frequency Coverage in kMc/s	V.S.W.R.	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges
WG 18	CD 18	1N26	12.0—18.0	Approx. 0.5: 1	2½" 63.5 mm.	4⅛"	2" 50.8 m.m.	5 oz. 142 grm.	Z830030
WG 16	CD 16	CV2154 CV2155	9.5—12.0	Approx. 0.5: 1	2⅞" 73 mm.	1⅝" 41.3 mm.	2⅞" 73 m.m.	6 oz. 170.1 grm.	Z830004
WG 15	CD 15	CV2154 CV2155	7.0—10	Approx. 0.5: 1	3" 76 mm.	6" 15.2 mm.	2½" 62.5 m.m.	1 lb. approx. 454 grm.	Z830034
WG 14	CD 14	CV2154 CV2155	5.0—7.8	Approx. 0.5: 1	3⅝" 92 mm.	9" 229 mm.	3¾" 95 mm.	32 oz. 908 grm.	Z830038
WG 12	CD 12	CV2154 CV2155	3.9—5.85	Approx. 0.5: 1	4" 101.6 mm.	10¼" 260 mm.	4¼" 108 mm.	56 oz. 1590 grm.	Z830042

Flanges: Details of all flanges fitted are shown on flange data sheet. Alternative British or American Flanges fitted to order.

Finish: Grade 1 Instrument Finish.

Crystals: These are not supplied with the detector unless otherwise requested.

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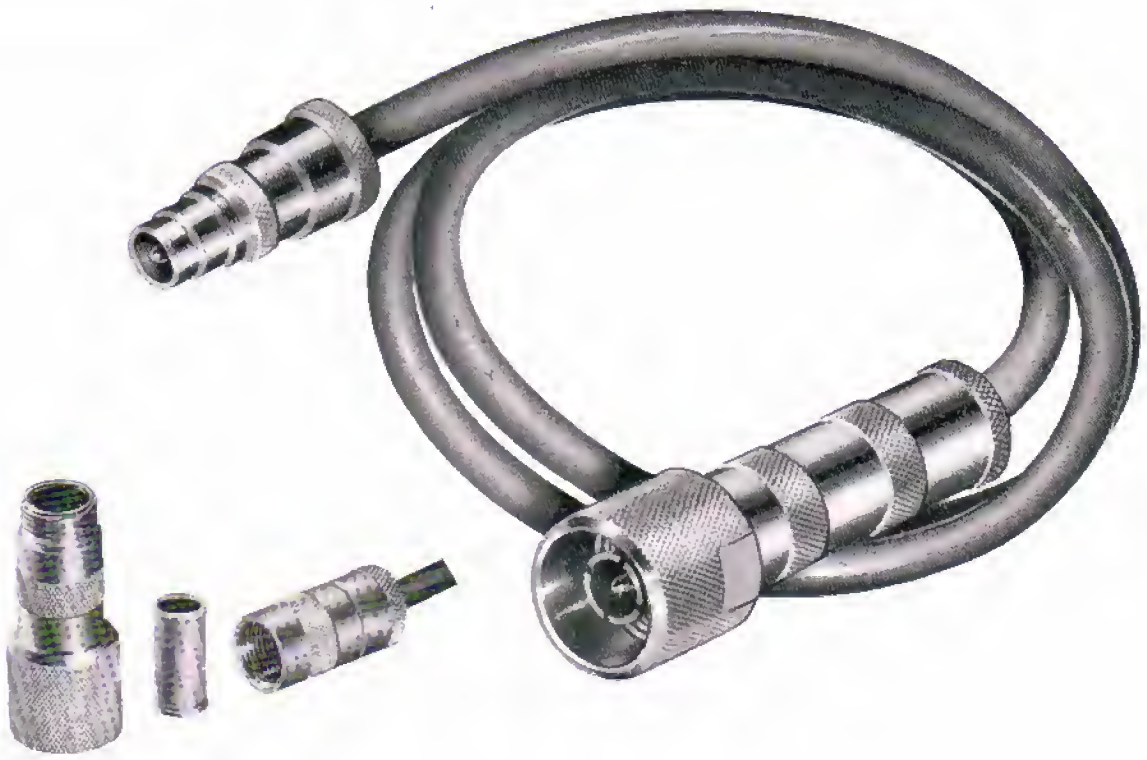
coaxial crystal detectors types CDC/C & CDN/C



This compact general purpose crystal detector is designed for use with coaxial crystals. The R.F. input is by means of a type N coaxial plug and the output end is designed to take a coaxial screened cable having a diameter over the dielectric of 0.128". 50 ohm cable can be fitted in lengths to order.

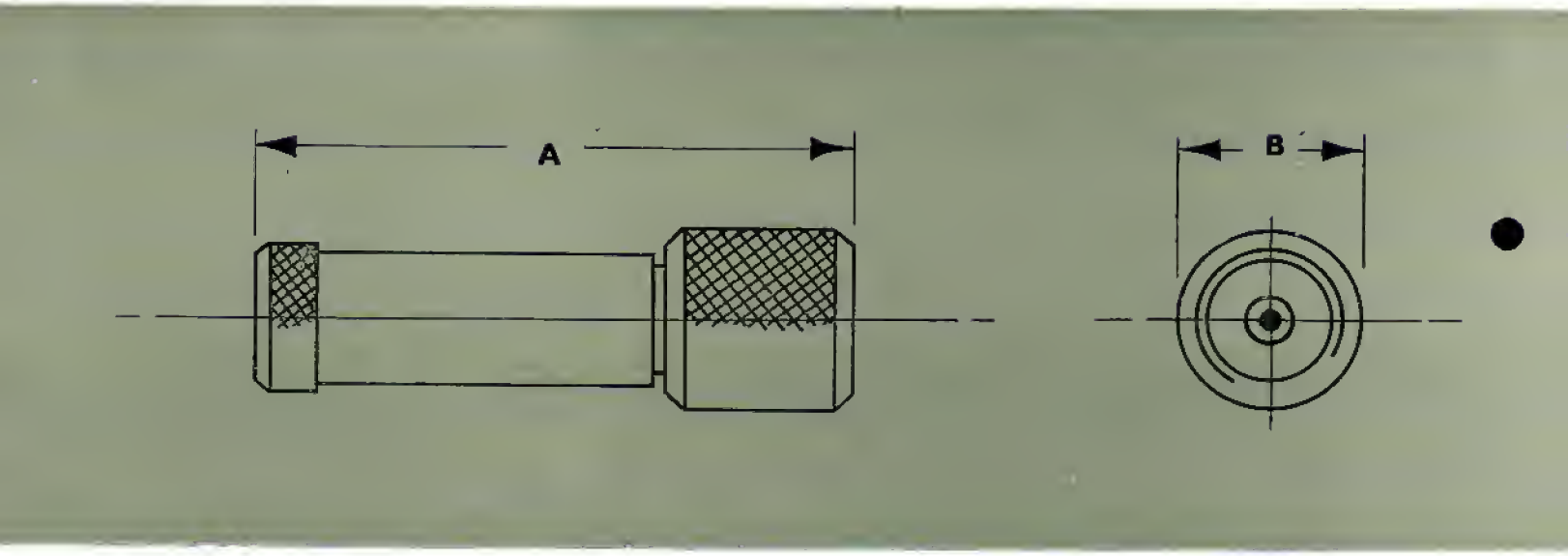
The frequency range 200 Mc/s to 24 kMc/s is covered by two units, the CD/C16 working from 200 Mc/s to 12kMc/s using CV2154 and CV2155 crystals and the CD/C18 working from 12 kMc/s to 24 kMc/s using 1 N26 crystals.

The main object of the design has been to obtain the maximum versatility. The R.F. bandwidth is as large as possible and the screening and filtering is adequate to allow the crystal to operate at all values of current from its own noise level to its maximum rating.

In a device such as this, certain penalties must be paid for the range of operating conditions. The R.F. input impedance is not uniform and may differ considerably from 50 ohms. The video output bandwidth is restricted by the shunt capacity of the R.F. filter which is 25pf. Thus at high current levels, where the crystal generator resistance is of the order of 200 ohms, a bandwidth of 10 Mc/s is possible in the open circuit case. At very low levels where the crystal impedance is of the order of 10,000 ohms, the bandwidth is then 200 Kc/s.

specifications

The R.F. input can be made by either a type N or a type C connector the type numbers being CDN/C or CDC/C respectively.



Type No.	Frequency Range	Type of Crystal	Reflected Power Loss	Dimensions A	Dimensions B	Weight*
CDC/C 18 or CDN/C	12-24 kMc/s	IN 26	About 5 db max.	$2\frac{5}{8}$" 66.7 mm.	$\frac{3}{4}$" 19 mm.	1oz. 28.4 grms.
CDC/C 16 or CDN/C	200 Mc/s-12 kMc/s	CV 2154 CV 2155	About 5 db max.	$2\frac{5}{8}$" 66.7 mm.	$\frac{3}{4}$" 19 mm.	1oz. 28.4 grms.

* Weight given is without crystal and connecting cable.

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Sanders

coaxial crystal detectors types CDC/S & CDN/S

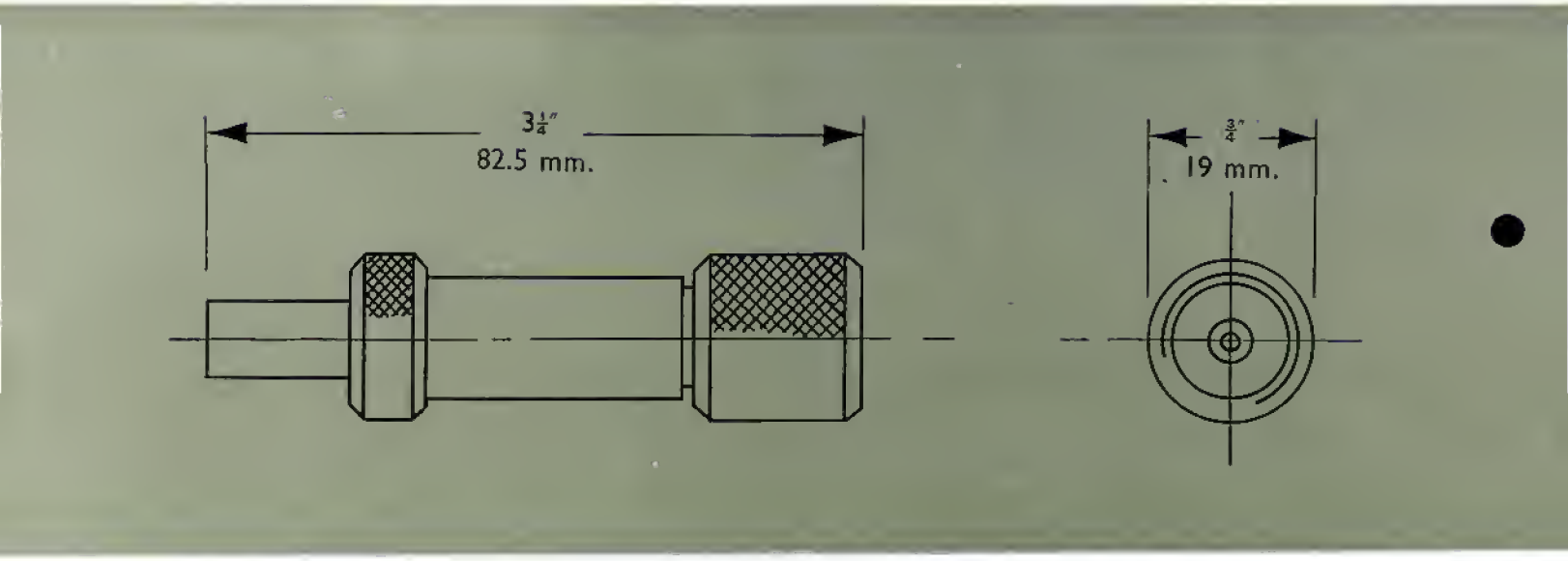
section C

These coaxial crystal detectors will hold type CV.2154 and CV.2155 Crystals. The R.F. input mates with a type N connector, in the case of the CDN/S and a type C connector in the CDC/C and the output is by a miniature BNC socket.

The B.N.C. plug to this socket, together with a three foot length of coaxial screened cable having a diameter over the dielectric of 0.128" can be supplied, together with crystals type CV.2154 and CV.2155, as optional extras.

Connection to the crystal, which is housed in an insulated sleeve of iron loaded araldite, is via a spring loaded contact. The surface of this contact presents a broad face to the top of the crystal thus allowing positive electrical connection to be made. This feature is particularly important when crystals having a large insulating cap at the top are used.

specifications



PERFORMANCE

R.F. Bandwidth: 200 Mc/s to 12 kMc/s.
Reflected power: Will not normally exceed 5db at worst.
Output capacity: 25pf.
Finish: Nickel plated brass.
Weight: 2½ oz. (71 grammes)

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Sanders

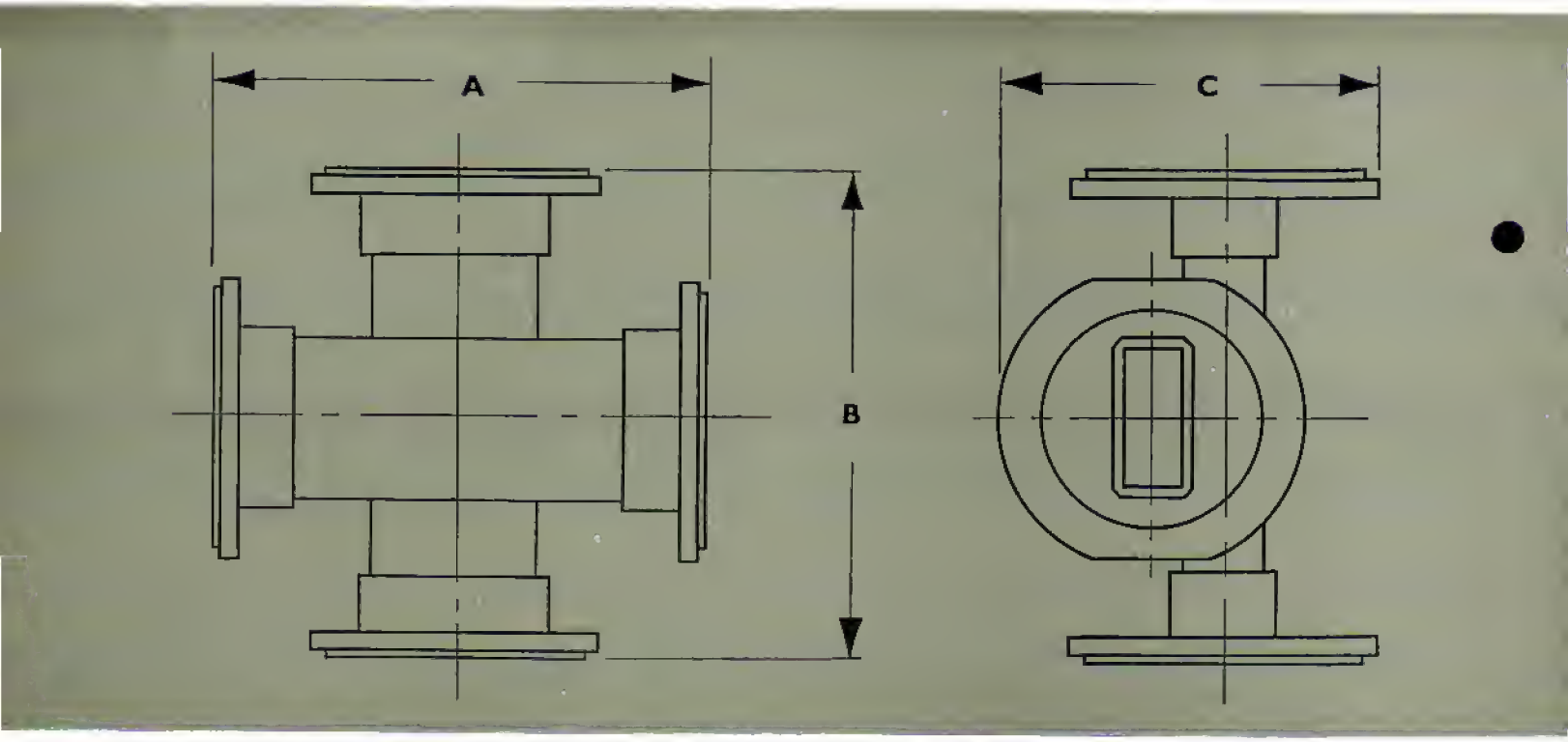
directional couplers

section D

Type DC

The coupling elements are of the double cruciform type combining the directional properties of the cruciform inductive slot coupler with the matching properties of the quarter wavelength spaced elements. In addition, there is a statistical probability that the directivity will be higher than that in the single element case. The use of two elements in this form also gives a considerable increase in the power handling capacity of the coupler which becomes close to the limiting value for the waveguide. The stability of attenuation obtainable with Directional Couplers is of great value in some applications. The attenuation of the forward component of the waveguide power is constant to better than 0.2 db for any terminating impedance of the main guide, within the 2:1 impedance circle. The D.C. type coupler is primarily of use for power monitoring in waveguide measuring benches and in high power C.W. and pulse systems. It may also be used after calibration as an attenuation reference standard and in other applications calling for stable and accurately known attenuation. Its use in waveguide bridge networks, or as a reflectometer, is not recommended as such systems require directitives of more than 40db in order to achieve reasonable accuracy.

specifications



Wave Guide Size	Type No.	Coupling in db	Directivity in db	Frequency coverage kMc/s	V.S.W.R.	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges
WG 18	DC 18/30	30	About 12	12.4-18.0	0.97: 1	$2\frac{3}{16}$" 55.5 mm.	$2\frac{3}{16}$" 55.5 mm.	$2\frac{3}{16}$" 55.5 mm.	$6\frac{1}{4}$oz. 77 grm.	Z830030
WG 16	DC 16/20	20	„ 27	8.2-10.5	0.97: 1	3" 76.2 mm.	3" 76.2 mm.	$2\frac{3}{8}$" 60.3 mm.	12oz. 340.2 grm.	Z830004
WG 16	DC 16/30	30	„ 27	8.2-10.5	0.97: 1	3" 76.2 mm.	3" 76.2 mm.	$2\frac{3}{8}$" 60.3 mm.	12oz. 340.2 grm.	Z830004
WG 16	DC 16/40	40	„ 27	8.2-10.5	0.97: 1	3" 76.2 mm.	3" 76.2 mm.	$2\frac{3}{8}$" 60.3 mm.	12oz. 340.2 grm.	Z830004
WG 15	DC 15/20	20	„ 27	7.0-9.5	0.97: 1	$4\frac{1}{2}$" 114.3 mm.	$4\frac{1}{2}$" 114.3 mm.	$2\frac{1}{2}$" 63.5 mm.	22oz. 623.7 grm.	Z830034
WG 15	DC 15/30	30	„ 27	7.0-9.5	0.97: 1	$4\frac{1}{2}$" 114.3 mm.	$4\frac{1}{2}$" 114.3 mm.	$2\frac{1}{2}$" 63.5 mm.	22oz. 623.7 grm.	Z830034
WG 14	DC 14/20	20	„ 27	5.85-7.8	0.97: 1	$4\frac{7}{16}$" 112.7 mm.	$4\frac{7}{16}$" 112.7 mm.	$3\frac{7}{8}$" 98.4 mm.	3lb. 1.36 kgrm.	Z830038
WG 14	DC 14/30	30	„ 27	5.85-7.8	0.97: 1	$4\frac{7}{16}$" 112.7 mm.	$4\frac{7}{16}$" 112.7 mm.	$3\frac{7}{8}$" 98.4 mm.	3lb. 1.36 kgrm.	Z830038
WG 12	DC 12/20	20	„ 27	3.95-5.3	0.97: 1	6" 152.4 mm.	6" 152.4 mm.	5" 127 mm.	4lb. 10oz. 2.1 kgrm.	Z830042
WG 12	DC 12/30	30	„ 27	3.95-5.3	0.97: 1	6" 152.4 mm.	6" 152.4 mm.	5" 127 mm.	4lb. 10oz. 2.1 kgrm.	Z830042

Variation in Coupling: Less than ± 2 db variation from nominal value over the frequency range for each wave guide size.

*Flanges: Details of all flanges fitted are shown on flange data sheet. Alternative British or American flanges fitted to order.

Finish: Grade I Instrument Finish.

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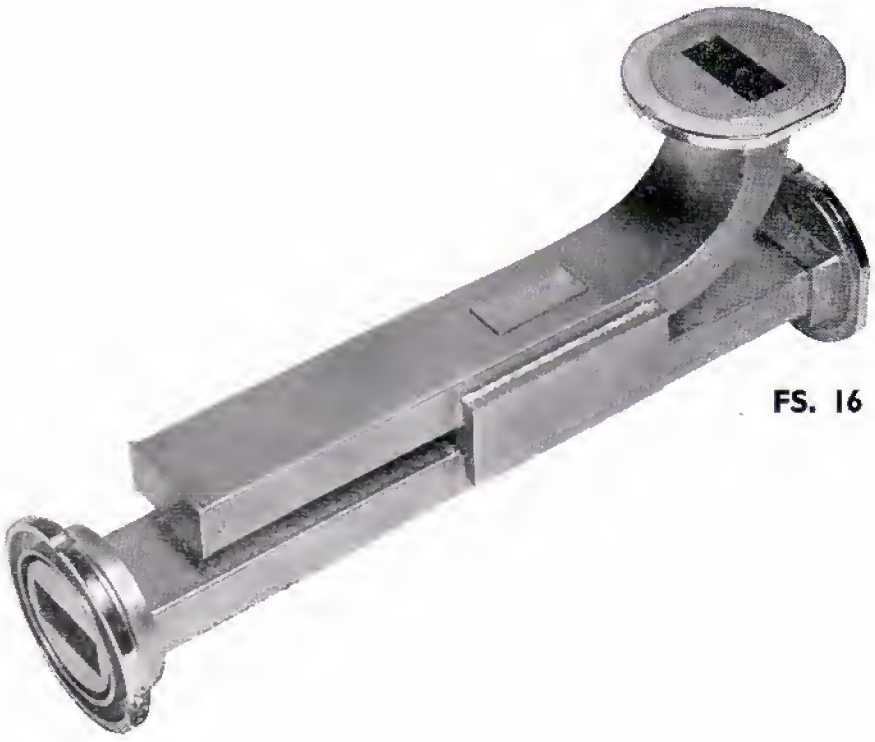
multi-slot directional couplers



FS. 16

These components are broad wall to broad wall couplers, with coupling elements in the form of quarter wavelength slots, the coupling coefficients of which are arranged to follow a binominal expansion.

By suitable adjustment of guide dimensions the reflection from the junction in the main arm has been reduced to a minimum over a wide band of frequencies. The V.S.W.R. is of the order of 0.95:1 over the frequency range for the waveguide size.

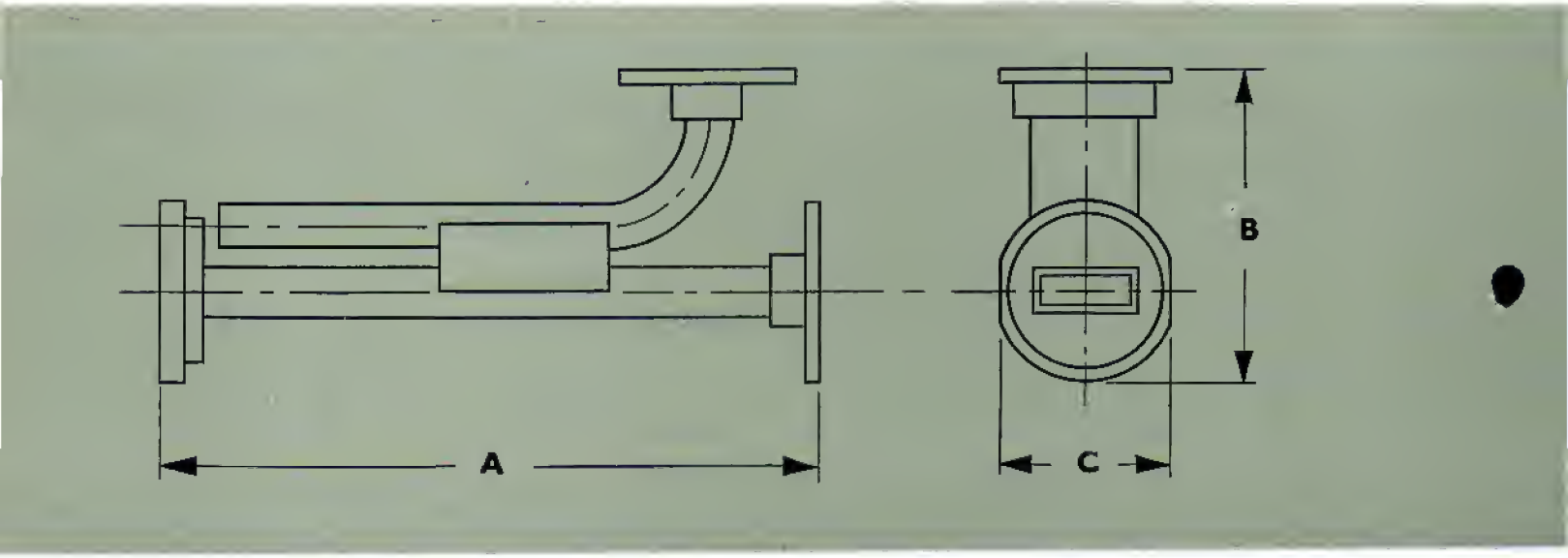
These couplers have a high power handling capacity. For example in WG 16 if the termination in the main guide has a V.S.W.R. of better than 0.7:1, the power handling capacity will be in excess of 100 watts. mean.

The auxiliary guide is terminated in a broad band dissipative wedge, the other end of which is turned upwards through a 90° E plane bend.

The directivity of the coupler is critically dependent on the spacing of the coupling elements. A directivity of better than 30 db is obtained by holding them to close tolerances.

The F.S. Type of coupler is suitable for waveguide test bench measurements in monitoring circuits, feeds for local oscillators, etc. In addition it may be used with a matching unit as a reflectometer for production testing.

specifications



Wave Guide Size	Type No.	Coupling (db)	Directivity (db)	Frequency Range k Mc/s	V.S.W.R.	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges normally fitted*
WG 18	FS18/10	10	35	12.4 –18.0	0.95: 1	12⅝" 320.7 mm.	2½" 63.5 mm.	1 $\frac{6}{10}$" 33.3 mm.	1 lb. 6¼ oz. 636 grm.	Z830030 on main arm both ends Z830029 on secondary arm
WG 16	FS16/3	3	30	8.5—10.0	0.95: 1	7½" 177.8 mm.	3½" 85.7 mm.	1¾" 44.5 mm.	1 lb. 7 oz. 650 grm.	Z830004 and Z830003 on main arms Z830004 on secondary arm
WG 16	FS16/10	10	30	8.5—10.5	0.95: 1	7½" 177.8 mm.	3⅜" 85.7 mm.	1¾" 44.5 mm.	1 lb. 7 oz. 650 grm.	Z830004—Z830003 on main arms Z830004 secondary
WG 16	FS16/20	20	30	8.5—10.5	0.95: 1	7½" 177.8 mm.	3⅜" 85.7 mm.	1¾" 44.5 mm.	1 lb. 7 oz. 650 grm.	Ditto
WG 15	FS15/10	10	30	7.5—10.0	0.95: 1	11½" 292 mm.	3⅝" 92 mm.	1⅞" 47.6 mm.	38 oz. 1075 grm.	Z830033 – Z830034 on main arms Z830034 secondary
WG 14	FS14/10	10	30	5.85—8.0 approx.	0.95: 1	13⅝" 344 mm.	5⅛" 130 mm.	3⅛" 79 mm.	76 oz. 2150 grm.	Z830037— Z830038 on main arms Z830038 secondary
WG 12	FS12/10	10	30	3.95—5.85 approx.	0.95: 1	17⅝" 447.7 mm.	7" 178 mm.	3⅝" 92 mm.	7 lb. 8 oz. 3525 grm.	Z830041 – Z830042 on main arms Z830042 secondary

Variation in Coupling: Less than ± 0.5 db variation from nominal value over the frequency range for each wave guide size.

*Flanges: Details of all flanges fitted are shown on flange data sheet. Alternative British or American flanges fitted to order.

Finish: All components are finished to Grade I Instrument Finish.

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klystron power unit
PUK. 250/350
MK. II

section E

This power unit is designed for low voltage klystrons having resonator-cathode voltages between 250 and 350 volts, and cathode currents not exceeding 40 mA. This includes the new British 'J' Band Kylstrons.

Facilities are provided for both cathode and reflector modulation as well as CW operation. All voltages and the cathode current are metered on an easy-to-read double scale meter. The reflector voltage control has a slow motion drive for ease of locating different modes of oscillation. The unit can be either rack mounted in a standard P.O. rack or inserted into a well-ventilated case.

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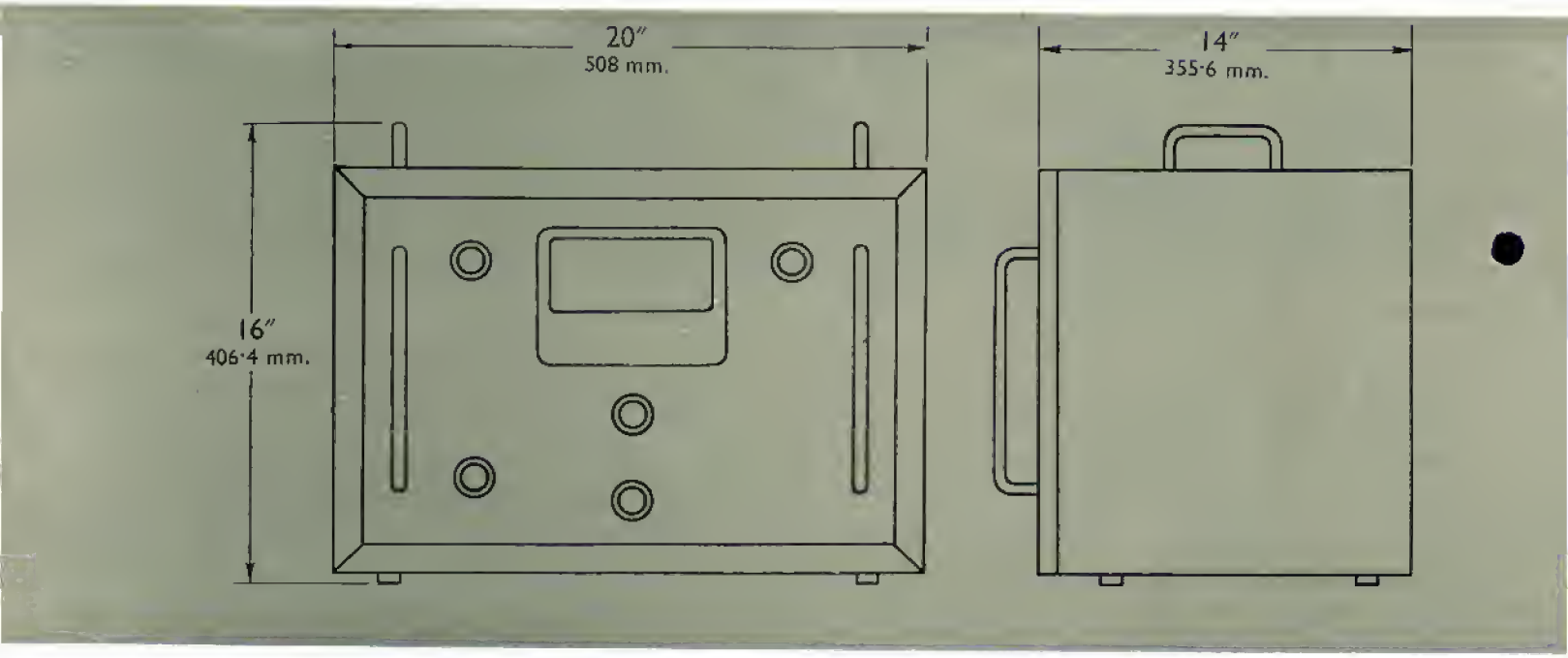
specifications



Control range volts cathode/E. 250–350 volts.

Maximum cathode current. 40 mA.

Peak-peak ripple, cathode//E. Less than 10 mV.

Output Impedance, cathode. 100–200 ohms.

Control range volts, reflector/E. 400–700 volts maximum.
300–550 volts minimum.

Peak-peak ripple, reflector/E. Less than 10 mV.

Output impedance, reflector. 230K ohms.

Trigger output voltage. Positive going 40 volts o/c width 20 usec at 50% amplitude.

Trigger output impedance. 220 ohms.

Mains inputs 50–60 c/s. 110, 220–250 volts.

Klystron heater supply. Variable, 4.75–6.5 volts metered 0–8 volts. Nominally 6.3 volts 1 amp.

(D.C. heater supply available to special order if required)

Finish: Light grey stove enamelled hammertone finish. Front panel painted light grey to BS. 381C Tint 631. Front outer frame black.

Weight: 53 lb. 10 oz.
(24.35 Kgs.)

MODULATION SELECTOR

Cathode :

i. Internal square wave, frequency 900 c/s to 3100 c/s.

ii. External via. coaxial socket on front panel. Input Impedance 400K ohms. Minimum voltages to modulate: 30 volts peak to peak square wave, 12 volts R.M.S. sine wave.

iii. C.W.

Reflector :

i. Off.

ii. External via coaxial socket on front panel. Input impedance 100K ohms. Minimum voltage to modulate: 31 volts peak to peak square wave.

iii. Internal trianguluar wave, 120 volts peak to peak obtained from the cathode modulator by integration. Positions (ii) and (iii) have an amplitude control on the front panel.

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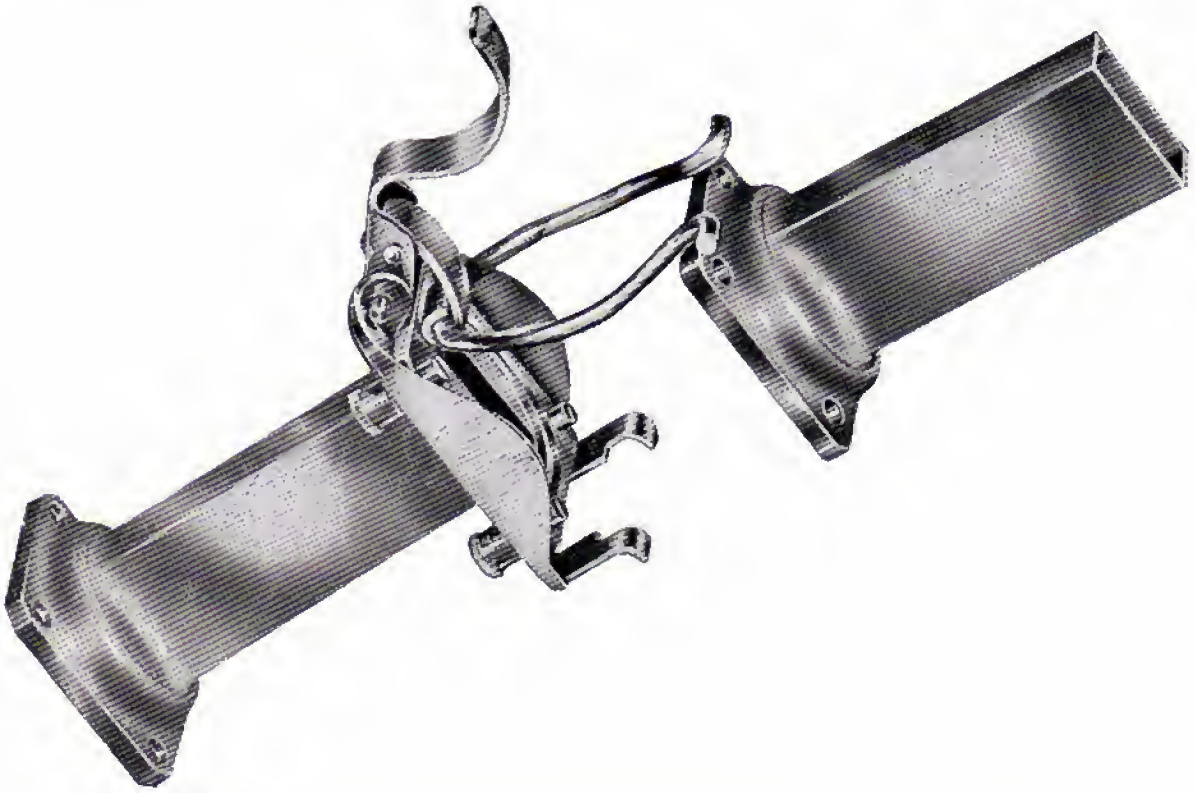
quick release clamps



These waveguide quick release assemblies have been designed for use where speed and/or accessibility is of major importance when rigid or flexible waveguide flanges are to be connected. There are no loose parts that might be lost when the coupling is disconnected. These units are particularly adaptable to airborne installation. Joints can conveniently be broken in many cases where it would be impossible to uncouple conventional flanges. This permits the easy removal of waveguide sections that might otherwise impair refuelling, gun loading, or radar system maintenance.

They are also useful for field or laboratory installations in connecting test equipment to a component or system with a minimum of time and effort, and may be readily operated in situations where only one side of the waveguide joint is accessible.

Fabricated from stainless steel and, in general, mounted directly on choke flanges they thereby become integral parts of the waveguide assembly. These Quick Releases are designed for us with American type tapped hole square choke flanges in the interests of standardisation and interchangeability, and have already been given Ministry of Supply approval. This feature is of significant importance when aluminium flanges are used because the threads of the choke flange are used only once, greatly reducing the possibility of thread wear. In addition, the aligning studs protruding from the choke assembly have no exposed threads and are held to accurate dimensions. As a result, consistent and

specifications

accurate flange-to-flange line-up is assured over long periods of use, and wear and tear on the plain flange holes is kept to a minimum. The small handle that opens and closes the mechanism swings out in the waveguide broad wall plane. Sanders Quick Release Clamps have been granted Ministry of Supply type approval as follows:

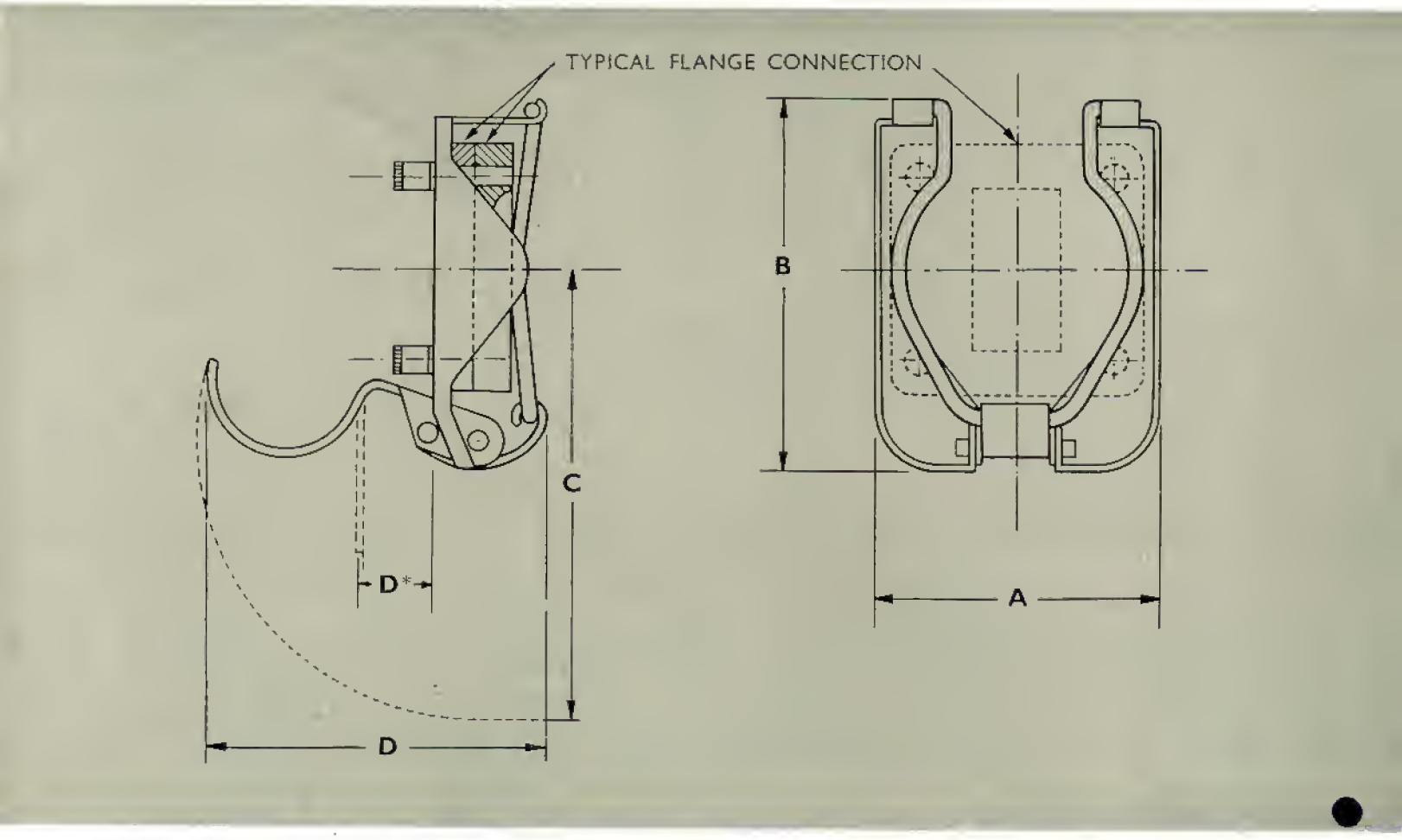
QRC 15—10AC/2600.

QRC 16—10AC/2711.

MATERIALS and FINISHES

All quick release clamp assemblies, including hardware, are fabricated entirely from stainless steel, 18/8, to Spec. B.S. En 58.

If the quick release clamp is to be used with other than the flange listed, your inquiry relating to such special application problems is invited. Similarly, we welcome your inquiries for quick release clamps in other waveguide sizes.



Part No.	Guide O.D. ins. mms.	A ins. mms.	B ins. mms.	C ins. mms.	D ins. mms.	D* ins. mms.	Weight
QRC 16	1.00 × .50 25.40 × 12.70	1.75 44.45	2.44 61.97	3.09 78.48	2.50 63.48	0.38	2¼oz. 64.8 grm.
QRC 15	1.25 × .625 31.75 × 15.87	2.12 53.84	2.75 69.83	3.12 79.24	2.50 63.48	0.38	2¼oz. 64.8 grm.

QRC 10. See notes below.

Note: In applications where handle operation is restricted, a special straight handle version D* above, is available to order.

Quick release clamps available for WG Size 10, flange type UG54/U. Details available on request.

transistorized VSWR indicator/ selective amplifier

The instrument is a small portable transitor amplifier and indicating meter for measuring weak modulated signals encountered in radiation field measurements and microwave test benches. It has self-contained battery supplies providing power for the amplifier and also bias current for power measuring bolometers.

The output is extremely stable, being independent of fluctuating mains supply voltages. It has printed circuit wiring with all its known advantages, and is, of course, suitable for both laboratory and field use.

The output meter is scaled in both 0 to 1 and ∞ to 1 V.S.W.R. scales together with a 0 to 0.5 Reflection Coefficient scale.

Facilities
1. Switching to monitor either of two A.C. inputs and bolometer input.
2. Balanced input to compare two anti-phase A.C. inputs.
3. Direct D.C. current readings on 0 to 100 micro-ampere meter.
4. Built-in bolometer bias-current supply.
5. Selective measurements at 1 Kc/s and 3 Kc/s.

Advantages

Portable.	Hum Free.	Non-microphonic.
Robust.	Printed Circuit Reliability.	Wide Input Range.
Quick Response.	Very Low Consumption.	Light Weight.

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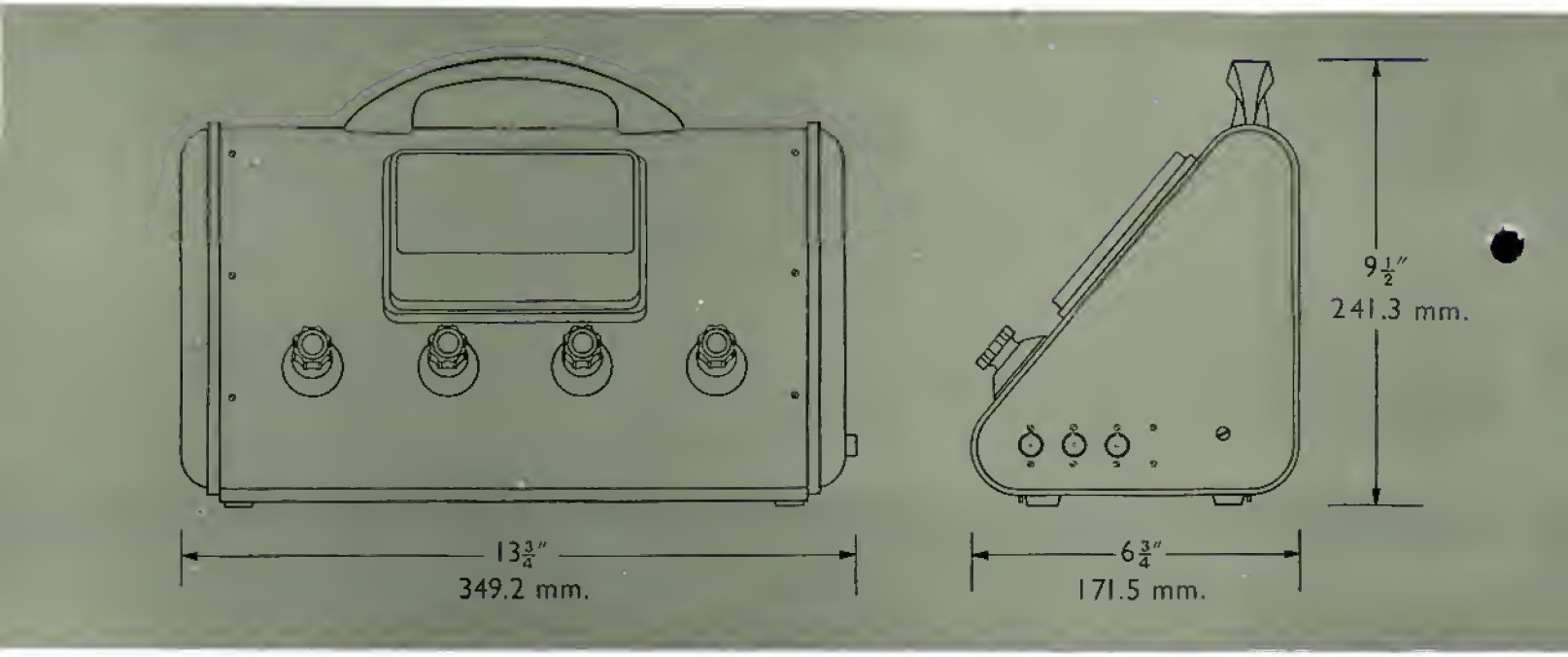
specifications



1. INPUT SELECTOR.

Off. When the instrument is switched off, the coaxial socket is directly connected to the meter movement. This measures D.C. current from 0 to 100 micro-amperes, and is particularly useful for measuring crystal currents in microwave applications, the inner conductor of the socket being positive.

A + B. In this position both coaxial inputs A and B are connected to the amplifier via a balanced transformer. This enables bridge measurements to be carried out when the inputs are of opposite phase. Very small changes can be examined with extreme accuracy.

A or B. Both inputs can be examined independently, avoiding the necessity for changing leads.

Bol Test. The meter is disconnected from the amplifier in this position and measures directly the bias current through the bolometer. Any current from 7 to 10 mA can be obtained but the most popular value of 8.5 mA is marked on the meter scale.

Bol. The modulated signal from the bolometer is applied to the amplifier via the coaxial socket BOL.

2. GAIN CONTROLS.

Coarse. A switched gain control having a range of 1,000 to 1 in 10 to 1 steps. It is also calibrated in decibels for convenience.

Fine. A continuously variable control calibrated to 20 db. With the combined controls, inputs of 1 micro-volt to 0.4 volt R.M.S. can be measured.

3. RESPONSE.

1 Kc/s or 3 Kc/s Selective. A tuned LC circuit is switched in at a fixed frequency of 1 or 3 Kc/s with a Q of approximately 30. This enables microwave test bench measurements to be carried out with the Klystron modulated at either frequency. This can, therefore, be used with both British and Continental klystron power units.
Noise, stray pick-up and mains interference outside the pass band are eliminated.

4. WIDE BAND.

Frequency response 3 db down at 350 c/s and 8 Kc/s.

Battery Supply: Ever-Ready PP.11 or BEREC PP. 11.

Weight 7 lbs. 14 ozs.
3.57 Kgs.)

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flexible waveguides

Flexaguide assemblies find wide use in ground and airborne radar systems by eliminating critical installation problems caused by dimensional variations between components within the system or between the installation and the system. Vibration and shock displacements are readily absorbed by Flexaguide due to its pliant quality.

The use of Flexaguide simplifies the complexity and cost of otherwise all-rigid waveguide assembly in installations where the waveguide run between components required many complex bends and twists. Flexaguide assemblies can satisfactorily replace expensive rotary joints in certain aerial systems compensated for pitch and roll. In the laboratory, Flexaguide assemblies simplify and speed up the connection between signal generators, standing wave meters and other microwave assemblies.

DESCRIPTION

The construction of Flexaguide begins with strips of Beryllium copper which are die-formed into 'U'-shaped corrugated half-guides. These are joined along the major neutral axis by hard—or soft—soldering. The bellows sections thus formed are heat-treated to give longer flexing life.

Hard soldering, when applied in the larger waveguide sizes to withstand the stresses of high pressurization, necessitates a sacrifice in bending ability in the H-plane only. Where the pressures involved allow soft-soldered Flexaguide to be used, the minimum bending radius is considerably smaller. The table overleaf gives minimum bending radii for both cases.

specifications

Suitable brass flanges are attached to the tubing and the assemblies moulded in a pliable synthetic rubber jacket which protects and supports the convolutions of the waveguide during flexing, and doubly ensures air-tightness in pressurised applications. These are of sufficient inherent strength that they may be used without a jacket if the application so requires. A mechanically strong adherent bond between the jacket and the metal portions of the guide is ensured by special bonding techniques including rubber locks incorporated in the flanges. The flexing life of the assembly is increased by a reinforcing tapered section of jacket which extends inwards from the flanges to distribute the bending stresses. The finished assembly is provided with the electrical surfaces silver plated. Flanges can be left clean brass if requested.

FEATURES

- M.O.S. Type Approval applied for.
- Eliminates alignment problems in the assembly of complex rigid waveguide systems.
- Isolates destructive vibration between components.
- Provides simple means of joining elements which move with respect to one another as in some pitch and roll compensated aerials.
- Retains flexibility from —55°C. to 125°C. For temperatures below —55°C, Flexaguide can be supplied with a Silicone rubber jacket.
- Can be pressurised for airborne or high power systems.
  "Threading" ability facilitates installation or dismantling of transmission lines in awkward situations.

MATERIALS AND FINISHES

Flexible tubing: Heat treatable Beryllium copper strip, silver plated on inner waveguide surface.

Flanges: Brass, silver plated, or unplated to order.

Jacketing: Neoprene rubber moulded jacket.

Weights of specific assemblies will be supplied on request.

Band	Waveguide Size	Equivalent Waveguide size O.D. (inches)	Attenuation (db/ft.)	Frequency range (kMc/s)	Nominal peak power megawatts	Maximum V.S.W.R.	Operating pressure p.s.i.	Minimum bending radius measured to centre line of waveguide E Plane	H Plane	
L	6	6.660 × 3.410	.025	1.12—1.70	10.0	Better than 0.95:1	20*	13.9″		27.0″*
S	10	3.000 × 1.500	.06	2.60—3.95	2.0	Better than 0.95:1	40*	4.5″	6.38″	17.0″*
C	12	2.000 × 1.000	.07	3.95—5.85	1.0	Better than 0.95:1	45*	3.88″	5.00″	12.0″*
C	14	1.500 × .750	.09	5.85—8.20	0.75	Better than 0.95:1	45*	2.50″	3.5″	10.5″*
Large X	15	1.250 × .625	.10	7.05—10.0	0.600	Better than 0.95:1	45	1.69″	2.50″	
Small X	16	1.000 × .500	.15	8.20—12.4	0.500	Better than 0.95:1	60	1.38″	2.25″	
J	18	.702 × .391	.20	12.4—18.0	0.20	Better than 0.95:1	60	1.25″	1.75″	
Q	22	.360 × .220	.40	28.5—38.0	0.05	Better than 0.95:1	60	1.06″	1.12″	

Note: Above values are based on straight sections. *The asterisk indicates hard-soldered assembly.

Ordering Instructions Standard assemblies are supplied in lengths from 6 ins. to 48 ins. in 6 in. multiples. Non-standard lengths available to order. Since it is not possible to stock moulds to cover all requested lengths, the right is reserved to charge for additional tooling required for odd lengths.
When ordering please state flange type and combinations required, e.g., Round I.S.S.C., square British American plain or choke, etc., and overall length required, using the following code: FG16 — 12 PC Round.
Flexaguide WG 16—12 inches long, plain flange one end, choke flange other, Round I.S.S.C.

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test bench isolators, type TBI

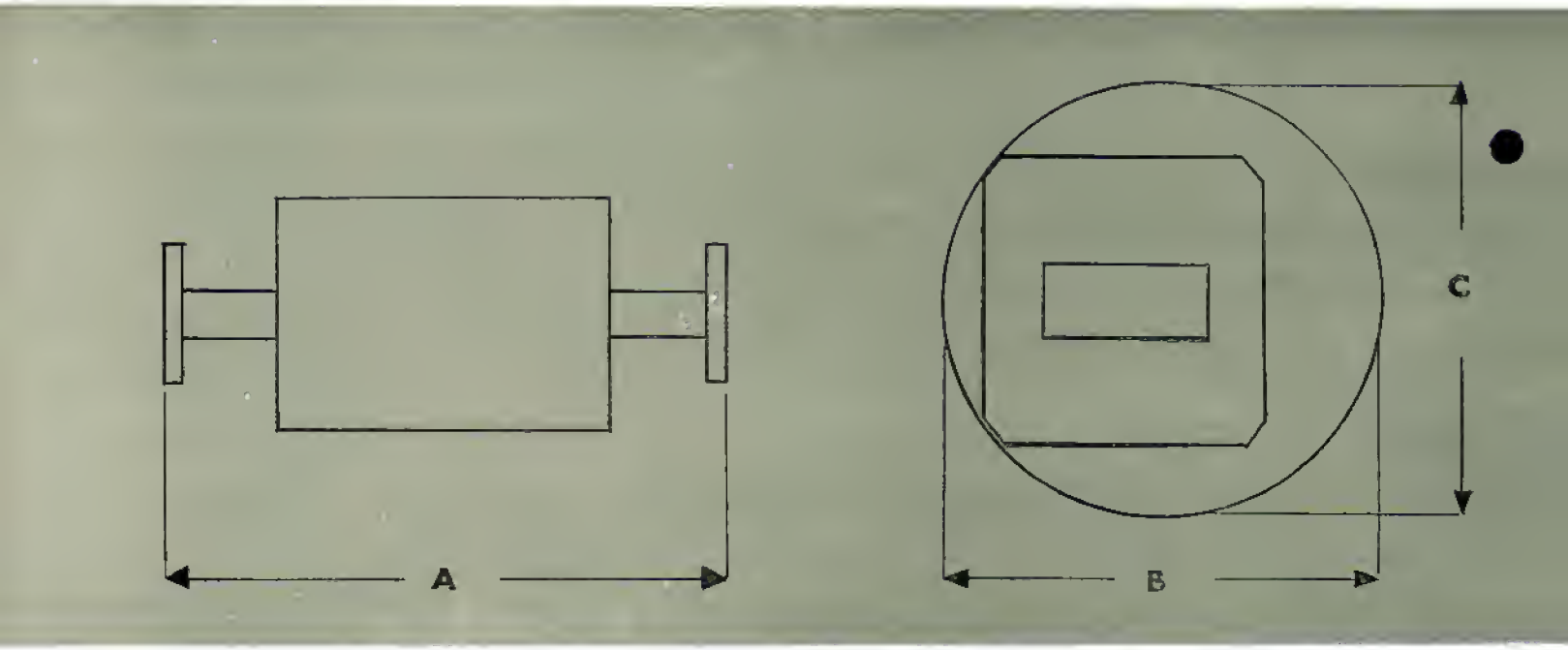
This ferrite isolator has been designed especially for test equipment applications and has a very high performance over an extremely broad frequency range. Covering all of the commonly used frequencies in X-band with no adjustments whatever, this single unit takes the place of the usual buffer attenuator between RF oscillator and waveguide bench.

The isolator combines a good match over the whole of its operating range with very low forward loss and high attenuation of energy reflected from subsequent mismatches. Thus frequency pulling of the RF source is avoided whilst full advantage is taken of the power available.

The design of the isolator is based on the principle of resonance absorption of RF energy by magnetized soft ferrite. A long thin section of ferrite is mounted approximately in the region of the waveguide where the RF magnetic field is circularly polarized. The field of a permanent magnet is applied parallel to the RF electric field vector to line up the spin axes of un-paired electrons in the ferrite material. Where the magnetic field strength is appropriate to the RF frequency, these electrons will precess in sympathy with the RF

specifications

magnetic field vector if this is rotating in the sense of the precession. Under these conditions, energy is extracted from the passing wave. In the case of a wave travelling in the opposite direction, the sense of circular polarization in the region of the ferrite is opposite to that of the electron precession and absorption does not take place.



Wave Guide Size	Type No.	Frequency Range (Kmc/s)	Average power (watts)	Isolation (minimum)	Insertion Loss (maximum)	Input V.S.W.R. (minimum)	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges
16	TBI 16/30	8.2-12.4	15	30 db	1.25 db.	0.87: 1	6″ 152.4 mm.	2½″ 63.5 mm.	2½″ 63.5 mm.	2lb. 10 oz. 1.17 kg.	Z830052 or Z830004

NOTES:

1. Power rating assumes load mismatch not worse than 2:1.
2. V.S.W.R. measurements taken under matched load conditions.

Flanges : Alternative flanges fitted to order — see flange data sheet.
Finish : Steel Blue metallic paint.

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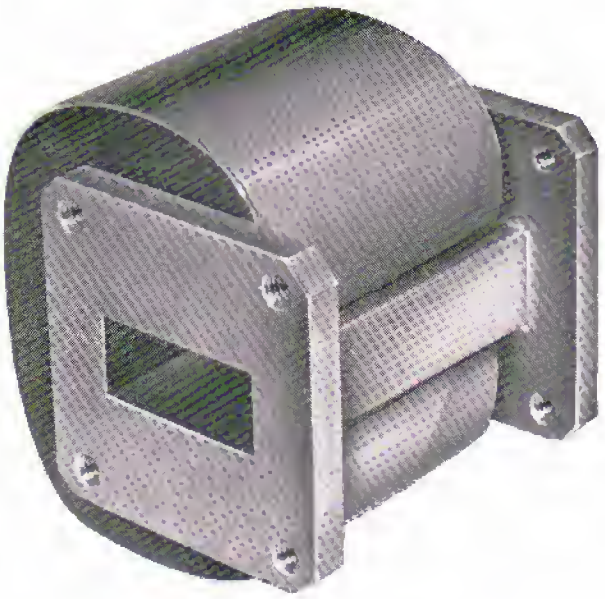
medium power ferrite isolators

section F



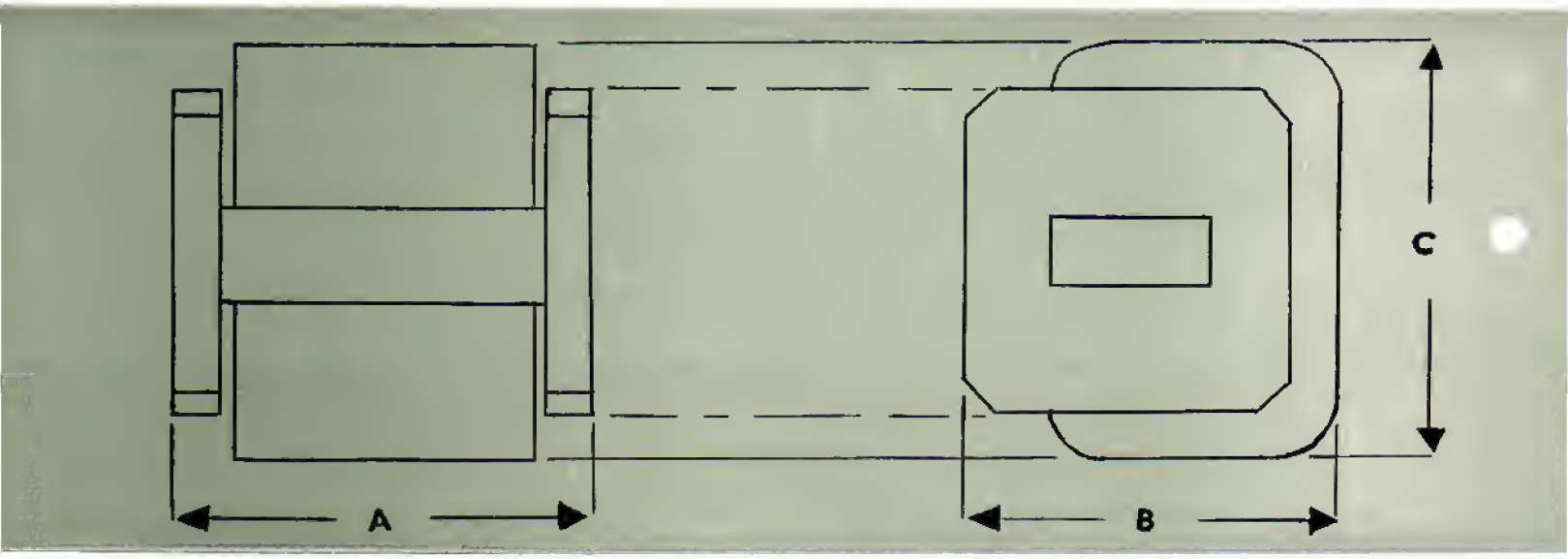
Ferrite devices, particularly isolators, are playing an increasingly important role in Radar and other Microwave Systems. If full use is to be made of the power available from a Magnetron or Klystron oscillator, it is essential that this stage sees a very good match. In a complex antenna arrangement, it is not always possible to avoid small and variable mismatches. If the reflected energy is allowed to reach the RF source, it can result in:-

(a) Frequency pulling.
(b) Amplitude and Phase variations.
(c) Ghost signals.
and (d) Damage to the valve.

Therefore, it is highly desirable that any RF energy returning towards the oscillator be greatly attenuated. The unique non-reciprocal properties of the ferrite isolator achieve this object with very little loss of forward-going power.

The present range of isolators offered by W. H. Sanders are of the resonance absorption type. Every effort has been made to miniaturize these with a view to their incorporation into airbourne as well as ground radar installations and test equipment. The magnets are normally encapsulated to give a large measure of protection against accidental contact with magnetic materials.

specifications



Wave Guide Size	Type No.	Frequency (kMc/s)	Peak and Average Power	Isolation (Minimum)	Isolation at Band Centre (Typical)
16	F 16/20	8.6-9.6	100kW-100W	20 db	30 db
16	F 16/20	8.6-9.6	100kW-100W	20 db	30 db

Insertion Loss (Maximum)	Input V.S.W.R. (Min:)	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges
0.7 db	0.90	2.00" 50.8 mm.	2.00" 50.8 mm.	2:35" 59.7 mm.	1lb. 6oz. 624 gm.	Square *
0.7 db	0.90	2.50" 63.5mm.	2.00" 50.8 mm.	2.35" 59.7 mm.	1lb. 9oz. 709 gm.	Z830004

* Similar to Z830052 but with tapped holes 8-32 UNF.

NOTES:

1. Power rating assumes load mismatch not worse than 2: 1.
2. V.S.W.R. measurements taken under matched load conditions.

Finish : Steel Blue metallic paint.

Flanges : Alternative flanges fitted to order. See flange data sheet.

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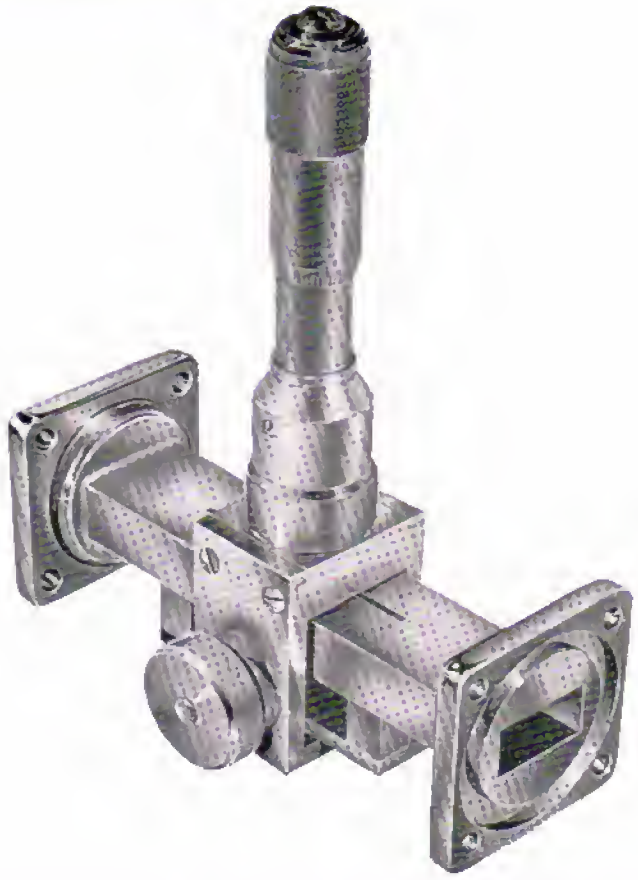
variable impedance



VI 18

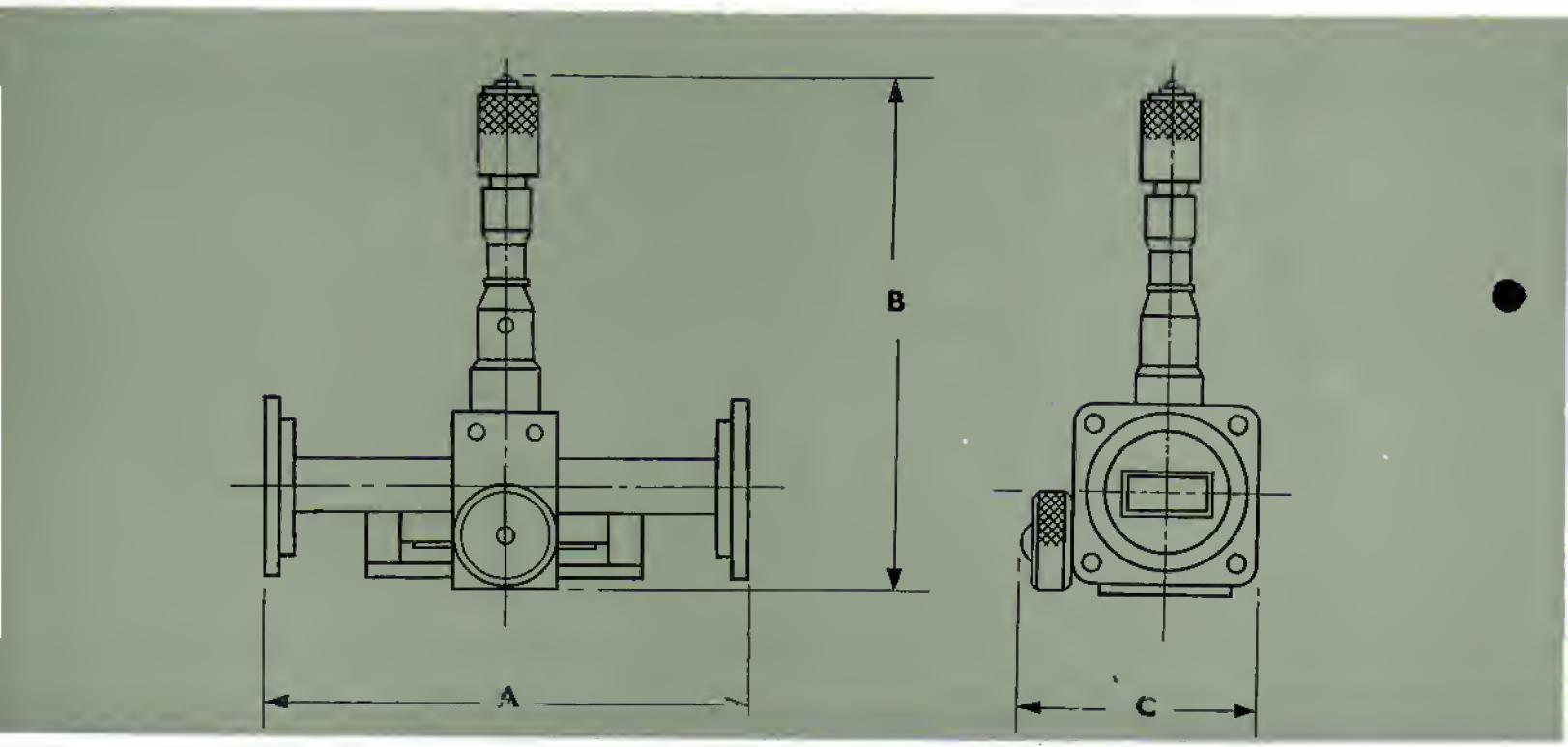
A complete range of impedance variation is provided in these instruments over the frequency range of the waveguide size by means of an adjustable, capacitive, probe.

The probe penetrates through the broad face of the waveguide, and moves in a longtuninal slot. The slot is carefully centred along the waveguide, and is so dimensioned as to be free from resonances, and radiation.

The degree of penetration of the probe into the waveguide is adjustable by means of a micrometer assembly. This assembly is mounted on a sliding block, which incorporates a tongue of metal protruding into the longitudinal slot in the waveguide and so shielding the probe up to the point of protrusion into the waveguide.

A smooth movement of the block is obtained by driving it over greater than one half of a guide wavelength at the minimum operating frequency by a friction drive bearing on the underside of the waveguide.

specifications



Wave Guide Size	Type No.	Frequency Range in kMc/s	Probe diameter	Probe Penetration	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges*
WG 18	VI 18	12.0—18.0	0.025″ 0.635 mm.	0.295″ 7.5 mm.	3½″ 88.9 mm.	3⅞″ 98.4 mm.	1 9/16″ 39.6 mm.	9½ oz. 269.5 grm.	Z830030 both ends
WG 16	VI 16	8.2—12.4	0.050″ 1.270 mm.	0.400″ 1.01 mm.	6″ 152.4 mm.	4 11/16″ 125 mm.	2¼″ 57 mm.		Z830003 and Z830004
WG 15	VI 15	7.0—10.0	0.050″ 1.270 mm.	0.488″ 1.24 mm.	6½″ 165 mm.	5 1/64″ 127.5 mm.	2½″ 63.5 mm.		Z830033 and Z830034
WG 14	VI 14	5.0 - 8.0	0.050″ 1.270 mm.	0.613″ 1.56 mm.	7″ 178 mm.	7″ 178 mm.	3⅜″ 85.7 mm.		Z830037 and Z830038

Finish: Grade I Instrument Finish.
Flanges: Alternative British or American Flanges fitted to order.
*Flanges on Flange data sheet.

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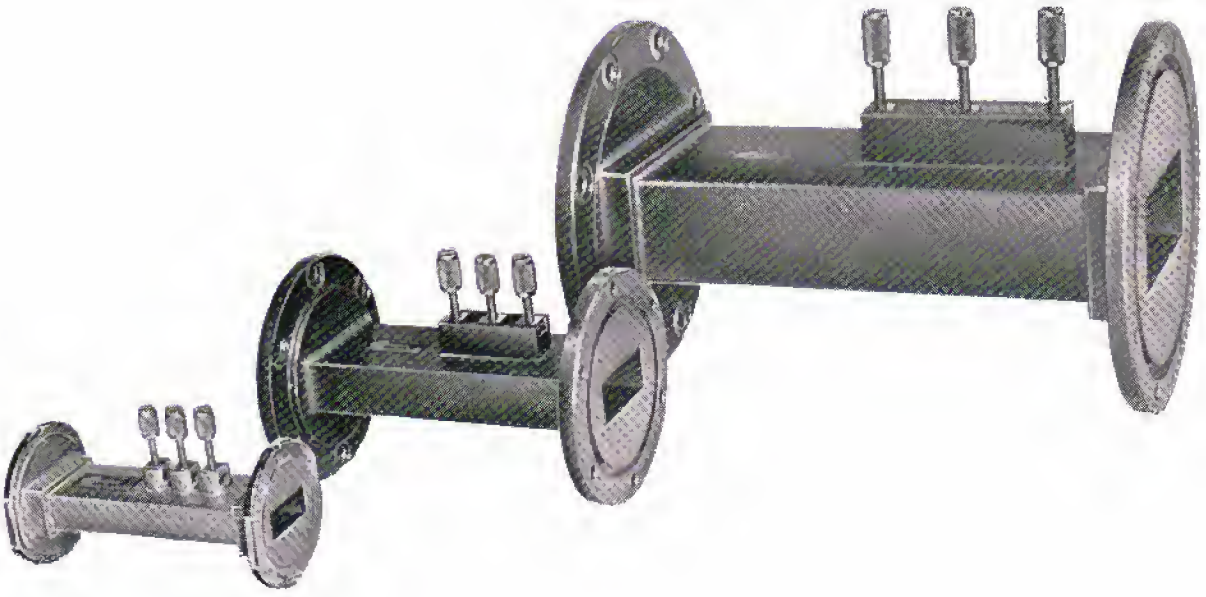
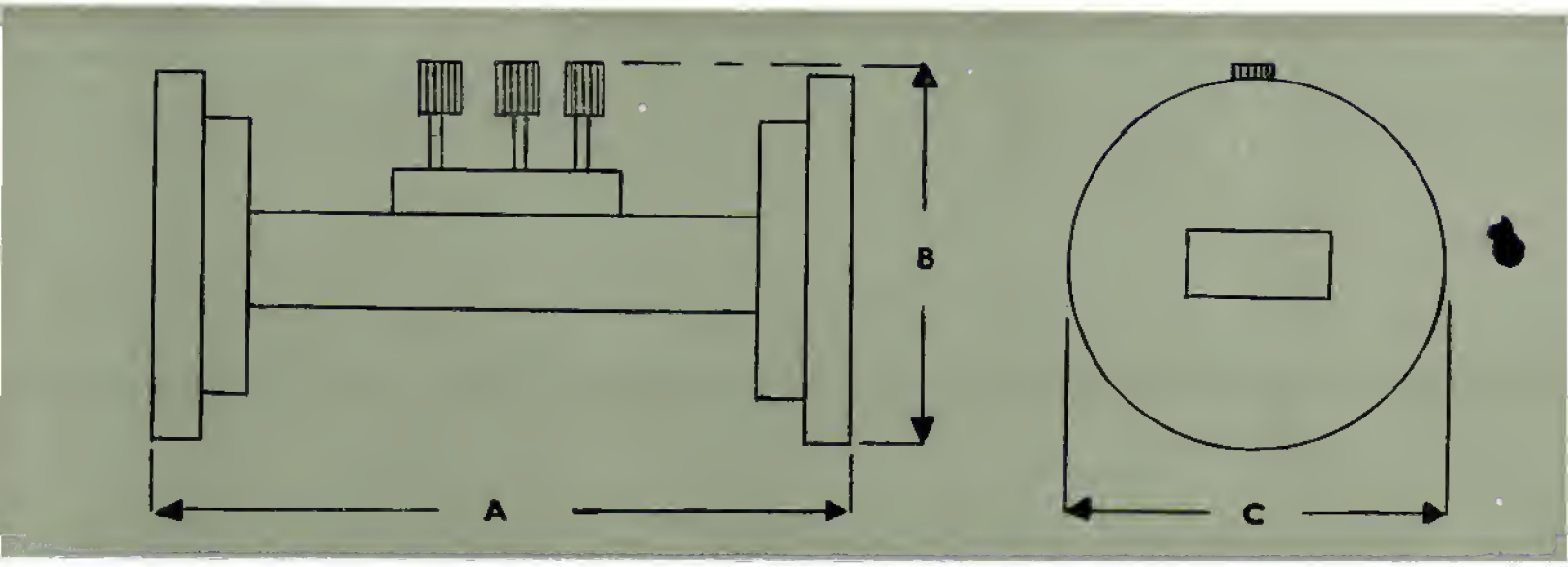
stub tuners



These units are short sections of waveguide having three screws penetrating the broad wall of the guide, and spaced approximately three eighths of a mean guide wavelength apart. The screws are rigidly held by a spring system which ensures constant setting during operation.

Stub tuners are widely used in the microwave laboratory where a quick method of matching is required.

specifications



Wave Guide Size	Type No.	Operating Frequency in kMc/s	Dimensions A	Dimensions B	Dimensions C	Weight	flanges
18	ST 18	12.0-18.0	$2\frac{5}{8}$" 66.7 mm.	$1\frac{5}{8}$" 41.3 mm.	$1\frac{5}{16}$" 33.3 mm.	4oz. 113.4 grm.	Z830030
16	ST 16	8.2-12.4	$3\frac{3}{4}$" 95.25 mm.	2" 50.8 mm.	$1\frac{3}{4}$" 44.5 mm.	8oz. 226.8 grm.	Z830004
15	ST 15	7.5-10.0	4" 101.6 mm.	2" 50.8 mm.	$1\frac{7}{8}$" 47.6 mm.	10oz. 285.5 grm.	Z830034
14	ST 14	5.85-8.0	$4\frac{3}{4}$" 120.7 mm.	$3\frac{1}{8}$" 79.4 mm.	$3\frac{1}{8}$" 79.4 mm.	$1\frac{3}{4}$lb. 794 grm.	Z830038
12	ST 12	3.95-5.85	$5\frac{3}{4}$" 146 mm.	$3\frac{5}{8}$" 92 mm.	$3\frac{5}{8}$" 92 mm.	2lb. 10oz. 1.19 kgrm.	Z830042
10	ST 10	2.60-3.95	8" 203.2 mm.	$5\frac{5}{16}$" 134.9 mm.	$5\frac{5}{16}$" 134.9 mm.	6lb. 2.72 kgrm.	Z830010

Finish : Grade I Instrument Finish.

Flanges : Details of all flanges fitted are shown on flange data sheet.

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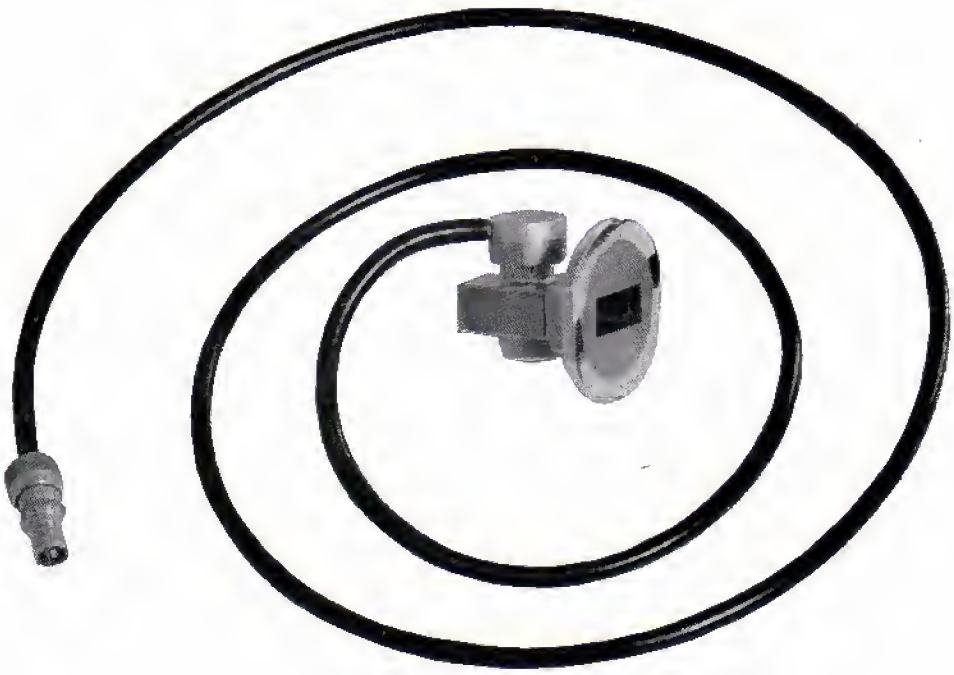
bolometer mounts

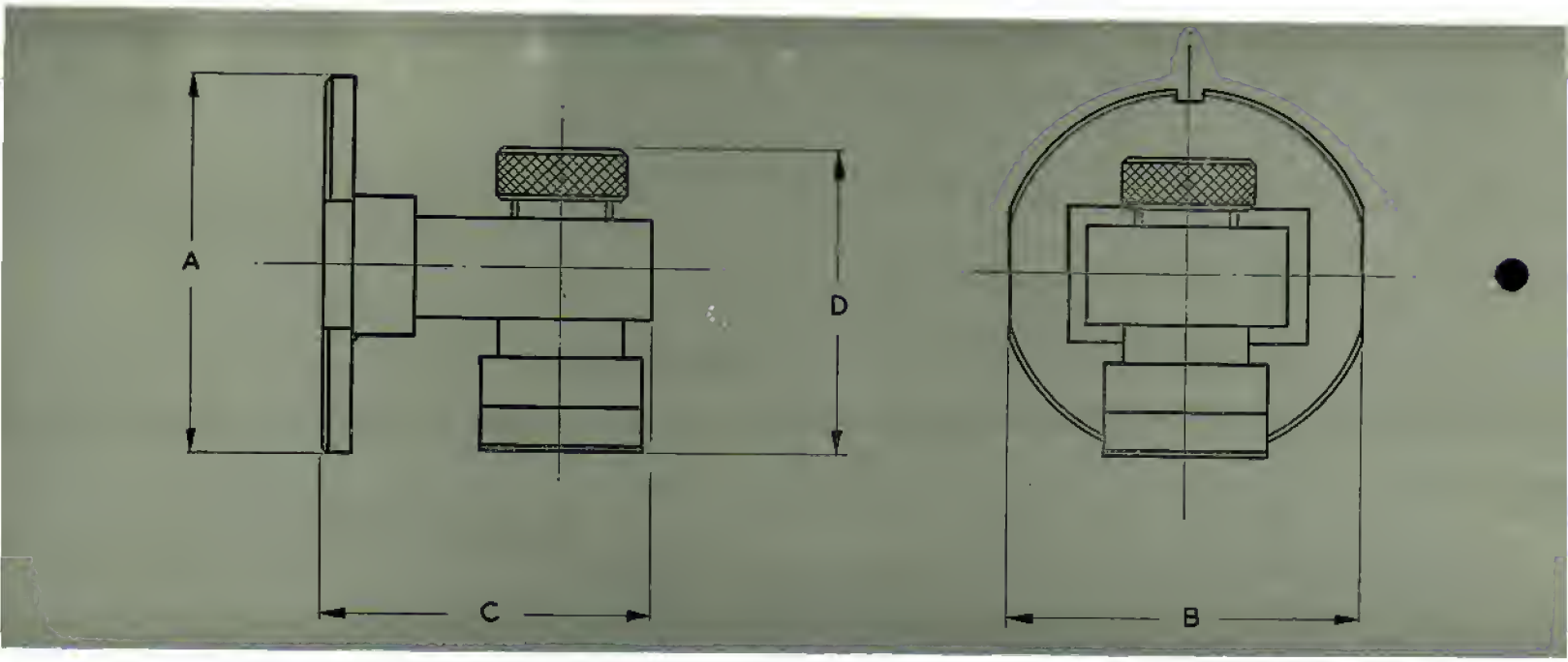


The characteristics of bolometers are more reproducible in manufacture than those of crystals; also, they remain more stable over long periods of time. The response of a bolometer is almost perfectly "square-law" (i.e., its resistance changes linearly with incident power), but its time constant is longer than that of a crystal, though shorter than that of a thermistor. Consequently, where consistency or accuracy of response is required, the bolometer is superior to the crystal, but speed of response and a small degree of ruggedness are sacrificed.

Two types of mount are available: firstly, the waveguide mount with the bolometer situated in a short length of short-circuited gusde giving about 6% bandwidth with V.S.W.R. about 0.7:1, and secondly, a coaxial mount similar to the CDN/S. The input to this type is via a type N connector, making it suitable for coupling to a W.H. Sanders Standing Wave Meter or to a coaxial-to-waveguide transformer. The output connection is a miniature BNC socket.

Both types of mount have been designed for optimal performance when a D.C. current of 8.75 mA is passing through the bolometer. They are then ideal for power monitoring and measuring when an accuracy of ± 0.5 db is required.

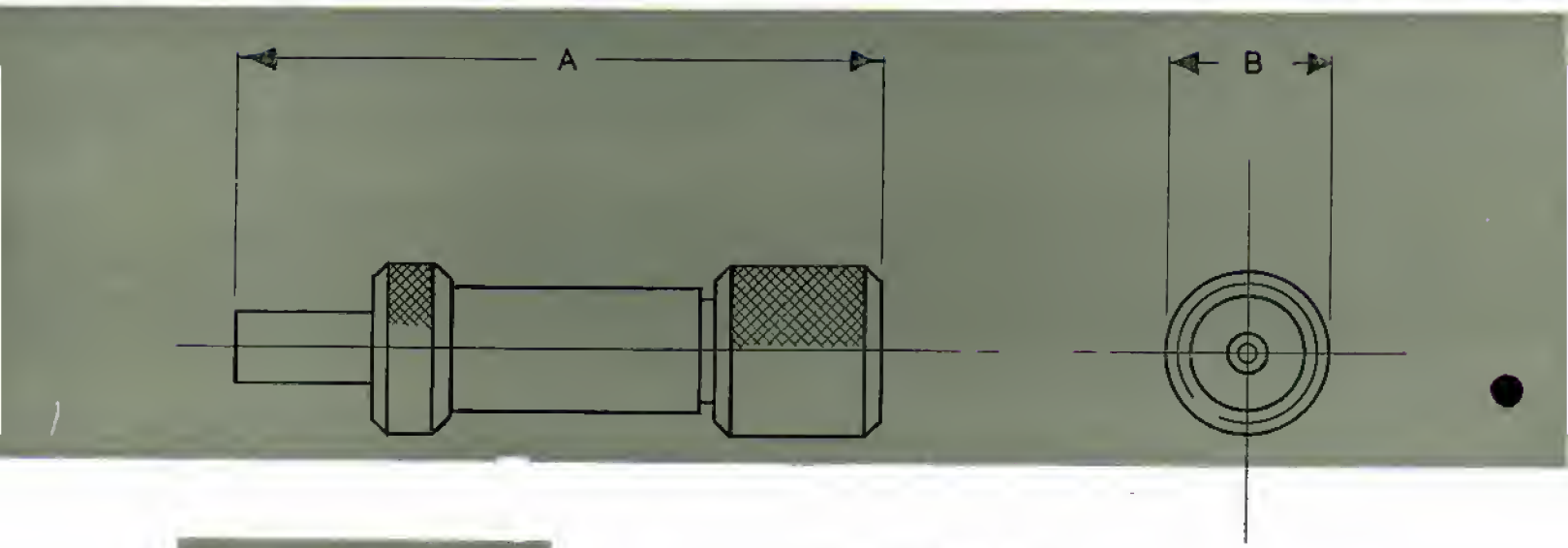
specifications



WAVEGUIDE MOUNTS

Waveguide Size	Type No.	Bolometer Type	Frequency Range	V.S.W.R. Min.	Dimensions A	Dimensions B	Dimensions C	Weight
WG16	BM16	N610B	8.0—10.0 kMc/s	0.5:1	$1\frac{7}{8}$" 47.6 mm.	$1\frac{5}{8}$" 41.3 mm.	$1\frac{3}{4}$" 44.5 mm	7 oz.* 198 gm.

* Weight with 3 feet of coaxial cable attached.



COAXIAL MOUNTS

Type No.	Bolometer Type	Frequency Range	Dimensions A	Dimensions B	Weight
CBM	N610B	200—12,000 Mc/s	$3\frac{1}{4}$" 82.6 mm.	$\frac{3}{4}$" 19.1 mm.	$2\frac{1}{2}$ oz. 71 gm.

BOLOMETER CHARACTERISTICS

Type N610B.
Bias Current 8.75 ± 0.25 mA.
Resistance 200 ohms at 25°C.
Sensitivity 4.5 ohms per mW.
Frequency range D.C. to 18,000 Mc/s.
Power rating 32 mW total power (bias power + 16 mW.).
Square-law response error less than 1% up to 0.2 mW. R.F.
Temperature range −40 to +80°C.

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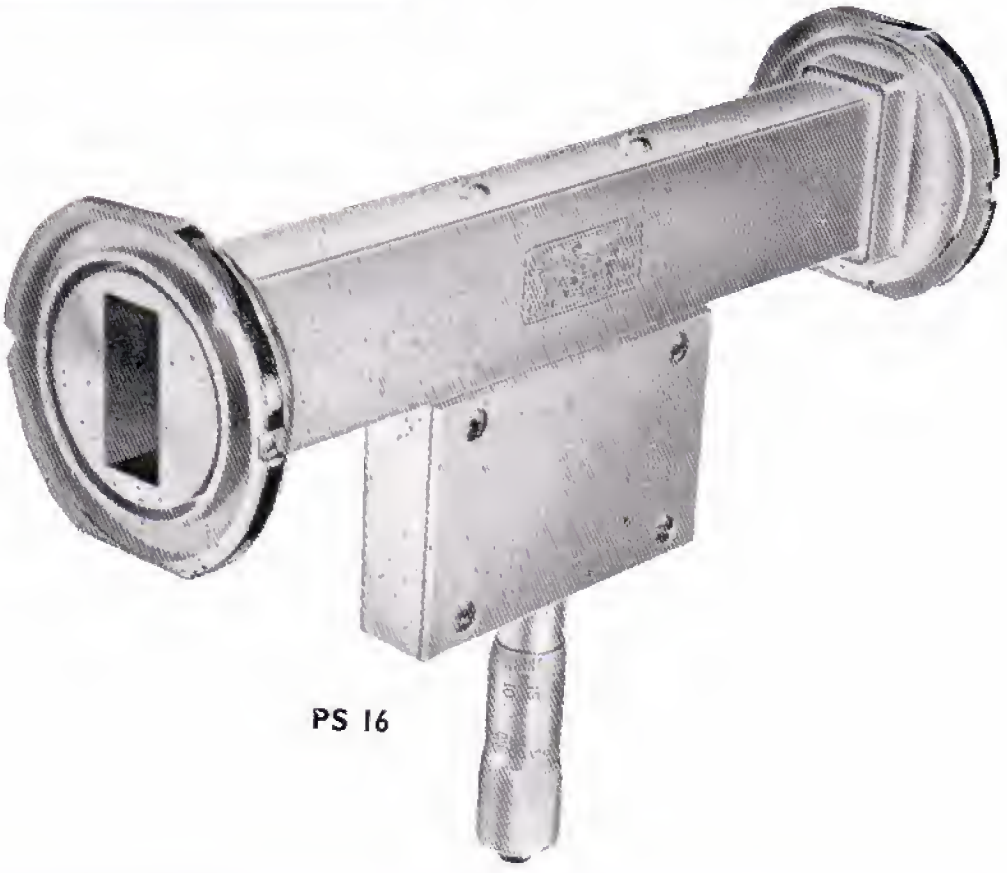
phase shifters



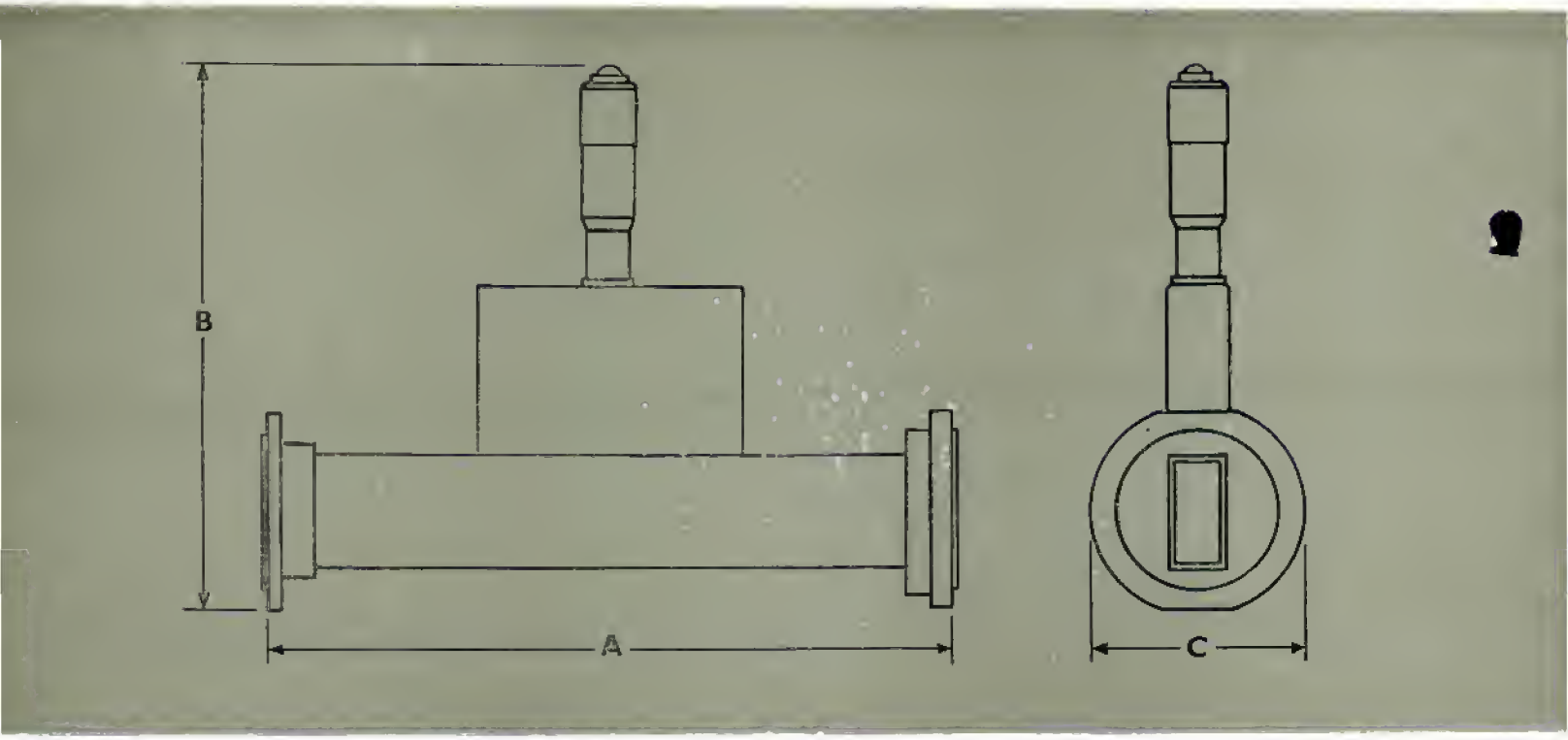
PS 16

Simplicity and low cost have been the main aims in designing these instruments, consistent with good accuracy and a reasonable match.

A stepped distrene element, supported by two push rods, is connected through a kinematic linkage to a micrometer. The relationship between micrometer movement and phase shift is necessarily a function of frequency. In cases where interpolation between the calibration figures provided is insufficiently accurate for measurements at an intermediate frequency, it is not difficult to re-calibrate the phase shifter using a good slotted line and calibrated variable short circuit.

The calibration figures provided at spot frequencies are in intervals of 36° (one tenth of a guide wavelength) up to 180°.

specifications



Wave Guide Size	Type No.	Frequency Coverage in kMc/s	Maximum Phase Shift	Calibration	Accuracy	Worst V.S.W.R.	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges
18	PS 18	12.4-18.0	180°	36°	±0.2°	0.8: 1	5½" 140 mm.	4" 101.6mm.	1 $\frac{5}{16}$" 33.3 mm.	10oz. 283.5 gm.	Z830030 and Z830029
16	PS 16	8.2-10.0	180°	36°	±0.1°	0.8: 1	6" 152.7 mm.	5" 127 mm.	1⅞" 48 mm.	15oz. 425 gm.	Z830004 and Z830003
15	PS 15	7.5-9.5	180°	36°	±0.1°	0.8: 1	9" 228.6 mm.	5" 127 mm.	1⅞" 48 mm.	1¾lb. 794 gm.	Z830034 and Z830033
14	PS 14	5.85-8.0	180°	36°	±0.1°	0.8: 1	10" 254 mm.	5¼" 146 mm.	3⅛" 79.2 mm.	2¾lb. 1.25 kgs.	Z830038 and Z830037
12	PS 12	3.95-5.80	180°	36°	±0.1°	0.8: 1	14½" 367.5 mm.	7½" 190.5 mm.	3⅝" 92 mm.	5lb. 2.27 kgs.	Z830042 and Z830041
10	PS 10	2.50-3.40	180°	36°	±0.1°	0.8: 1	17" 431.8 mm.	9" 229 mm.	5 $\frac{5}{16}$" 134.9 mm.	7½lb. 3.4 kgs.	Z830010 and Z830009

Finish : Grade 1 B.S.I. Instrument Finish.
Flanges : Details of flanges fitted are shown on flange data sheet.

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short circuit

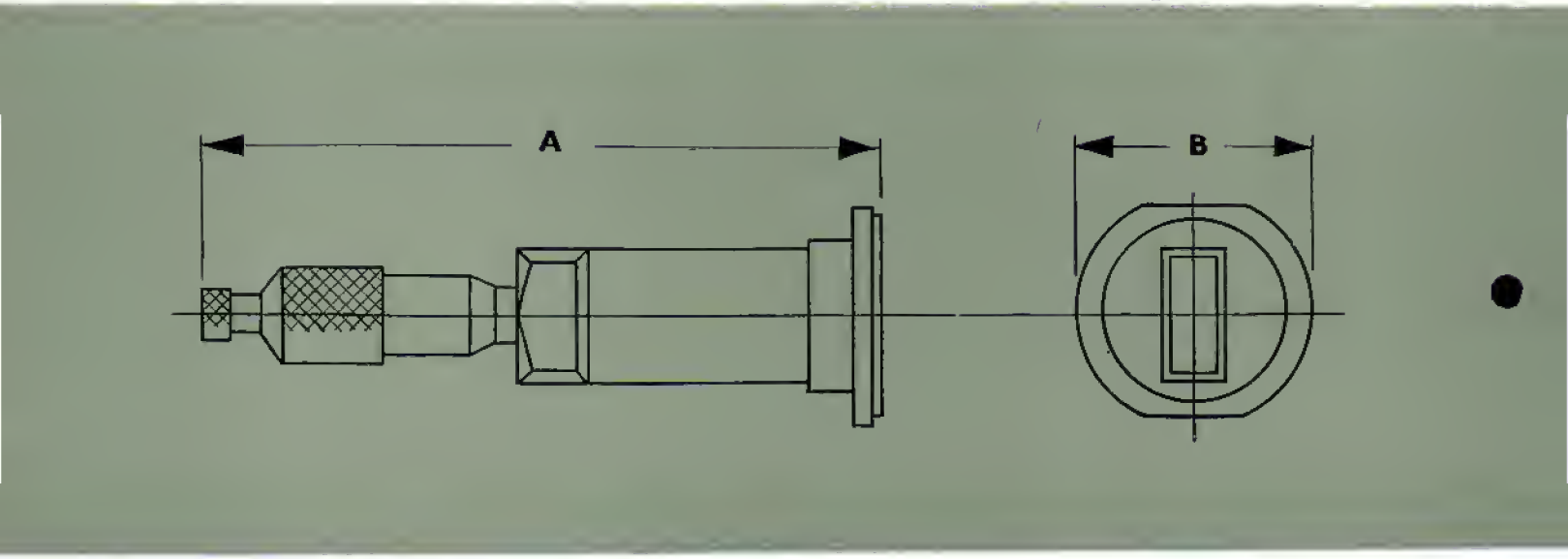
SC 16

This instrument is designed to give satisfactory performance over the entire recommended frequency range of the waveguide size.

The use of anodised duralumin for the short circuiting plunger, makes it possible to dispense with spring fingers needed to counteract variable contact in the more conventional choke type plunger.

The electrical reflecting plane coincides closely with the front face of the plunger, and the need for recalibration on change of frequency is very much reduced. The filter thus remains effective over a very wide range of frequencies. In addition, the anodised layer forms a durable bearing surface giving trouble free operation over a long period of use. The instrument is supplied with a micrometer adjustment for accurate setting and the movement is kinematically designed to be free from backlash. Aperture discontinuities may introduce a cyclical error to the measurement of phase angle. To minimise this the characteristic impedance of the termination is controlled in manufacture to within 0.3% of nominal. In addition, the cut-off wavelength of the termination is controlled to within 0.1% of nominal.

specifications



Wave Guide Size	Type No.	Frequency Range in kMc/s	V.S.W.R. of plunger in db.	Dimensions A	Dimensions B	Weight	Flanges*
WG 18	SC 18	12.4 to 18	Greater than 40 db.	$6\frac{1}{8}$" 161.9 mm.	$1\frac{5}{16}$" 33.3 mm.	11 oz. 312 grm.	Z830030
WG 16	SC 16	8.2 to 12.0	Greater than 46 db.	$6\frac{1}{4}$" 158.8 mm.	2" 50.8 mm.	8 oz. 226.8 grm.	Z830004
WG 15	SC 15	7.0 to 10.0	Greater than 46 db.	6" 152 mm.	$1\frac{7}{8}$" 47.5 mm.	10 oz. 284 grm.	Z830034
WG 14	SC 14	5.00 to 7.8	Greater than 46 db.	$8\frac{5}{8}$" 218 mm.	$3\frac{1}{8}$" 79 mm.	24 oz. 682 grm.	Z830038
WG 12	SC 12E	3.95 to 5.8	Greater than 46 db.	$10\frac{3}{4}$" 273 mm.	$3\frac{5}{8}$" 92 mm.	38 oz. 1079 grm.	Z830042

Finish: Grade 1 Instrument Finish.
*Flanges: Alternative British or American flanges fitted to order.
For details see flange data sheet.

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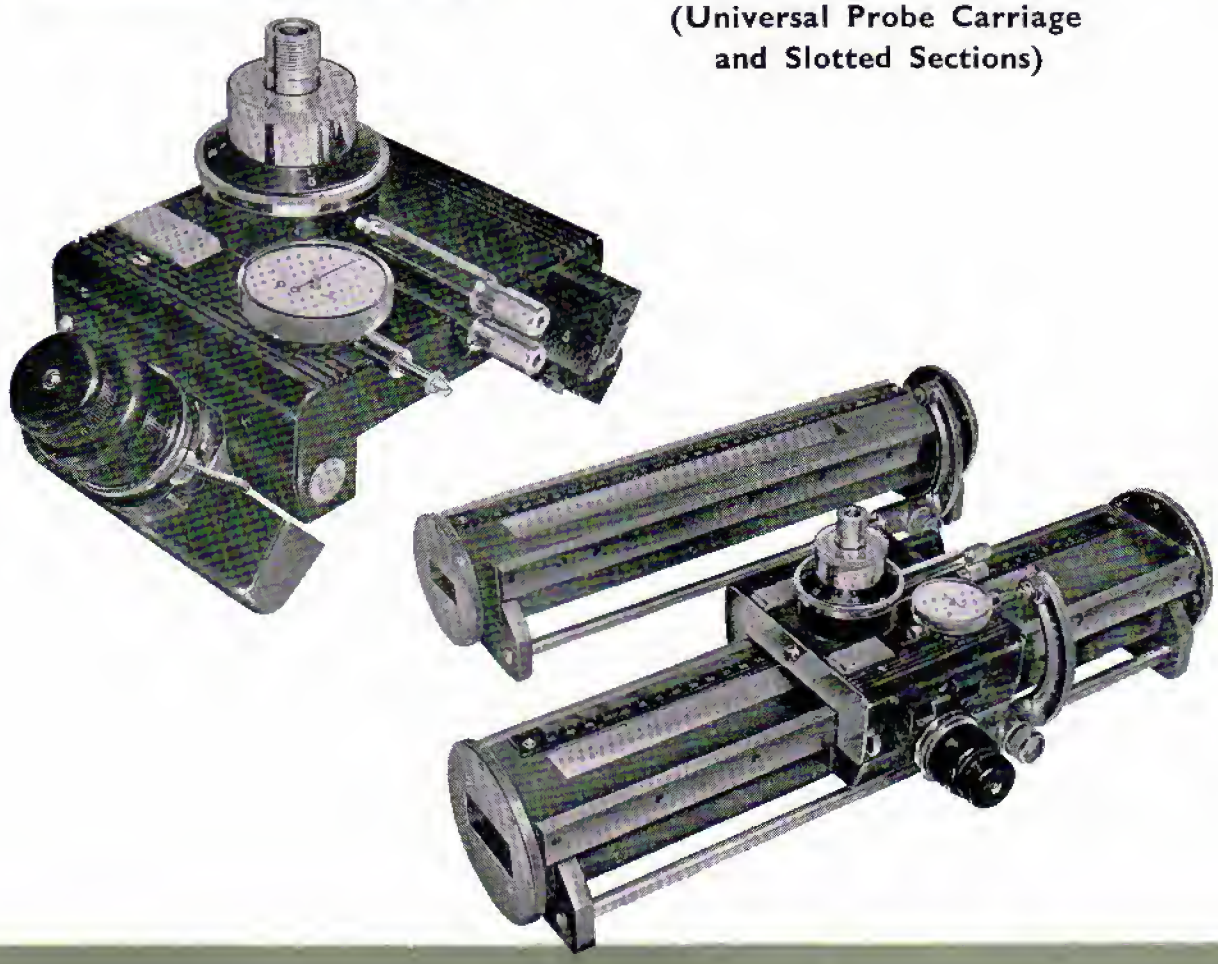
universal standing wave detector

(Universal Probe Carriage and Slotted Sections)



This equipment consists of a universal probe carriage assembly, and a series of waveguide slotted sections in waveguide sizes 10 to 16, By selecting the desired waveguide size, together with a Universal Probe Carriage assembly, the user is able to carry out impedance measurements at any frequency in the range 2.0 – 12.5 kmc/s.

The channel is accurately machined from aluminium and is stress relieved to ensure a stable structure. A scale bar is attached to indicate the position of the probe with respect to one flange. Rigidly pinned to the channel are two guide bars which are used as bearing surfaces for the carriage movement. These bars are adjusted during manufacture to eliminate the effect of the attenuation of the channel upon the standing wave being measured.

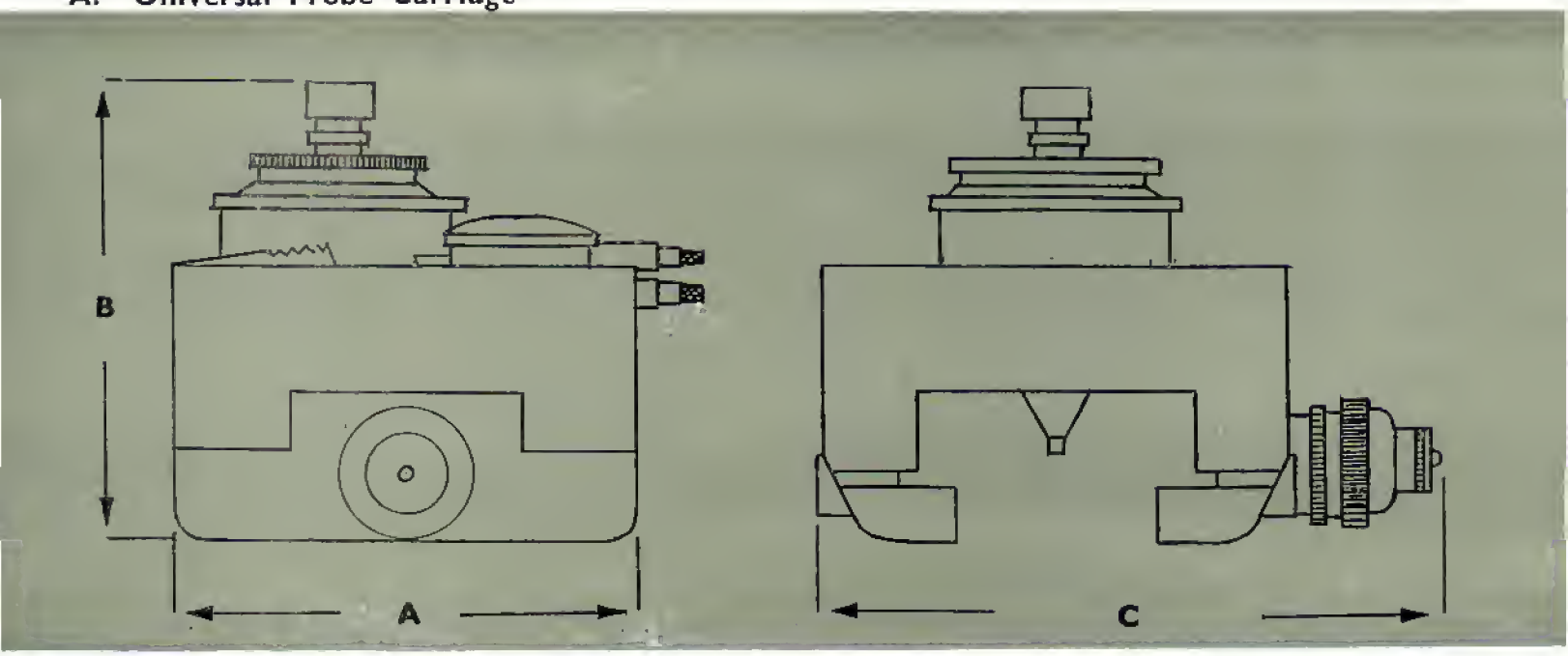
The carriage is located on the guide bars according to kinematic principles by means of five rollers. Its position along the axis of the waveguide is established to one tenth of a millimeter by the use of a vernier scale. For more accurate measurements of position a dial gauge is incorporated in the carriage and can be brought to bear against a stop to indicate the position of the carriage within any one millimeter to an accuracy of 0.01 mm. The carriage can be detached from any channel by depressing two buttons which release the carriage sides and allow them to swing outwards. It can then be lifted from the channel and placed on to another of different waveguide size.

specifications

The carriage sides, when pushed downwards and inwards again, automatically lock into accurately determined positions. The whole operation takes less than 20 seconds and the final position of the carriage is accurately reproducible. A slow and fast motion friction drive is used to move the carriage along the channel. The probe is adjustable in height continuously but the optimum depth for maximum accuracy in any particular channel is indicated on the adjustment mechanism.

The RF output from the probe is fed to a type N connector on the carriage and can be led directly to a superheterodyne receiver, or alternatively, rectified by using a coaxial crystal detector. The coupling of the probe varies only slightly with frequency due to the fact that two reactive tuning stubs are provided to match the output system to the probe. With the probe in its optimum position and the tuning stubs adjusted for maximum output the coupling loss is about 23 db. This can be reduced by increasing the probe depth but then there is a danger of errors caused by reflection from the probe. This is insignificant when measuring severe mismatches but must be considered when investigating components with reflection coefficients near zero. In the optimum position of the probe, the probe reflection coefficient is less than 0.01 and an absolute accuracy of 0.5 % impedance is obtained.

A. Universal Probe Carriage



Wave Guide Coverage	Type No.	Drive	Coupling	Voltage Probe Reflection coefficient	Frequency Coverage in kMc/s	Dimensions A	Dimensions B	Dimensions C	Weight
10, 11, 12, 13, 14 15, 16	UPC 10/16	Friction	23 db	Less than 0.01	2.0 - 12.5	4″ 102 mm.	5⅛″ 130 mm.	7⅞″ 200 mm.	8.b. 3.63 kg.

Finish : Black anodised and chrome.

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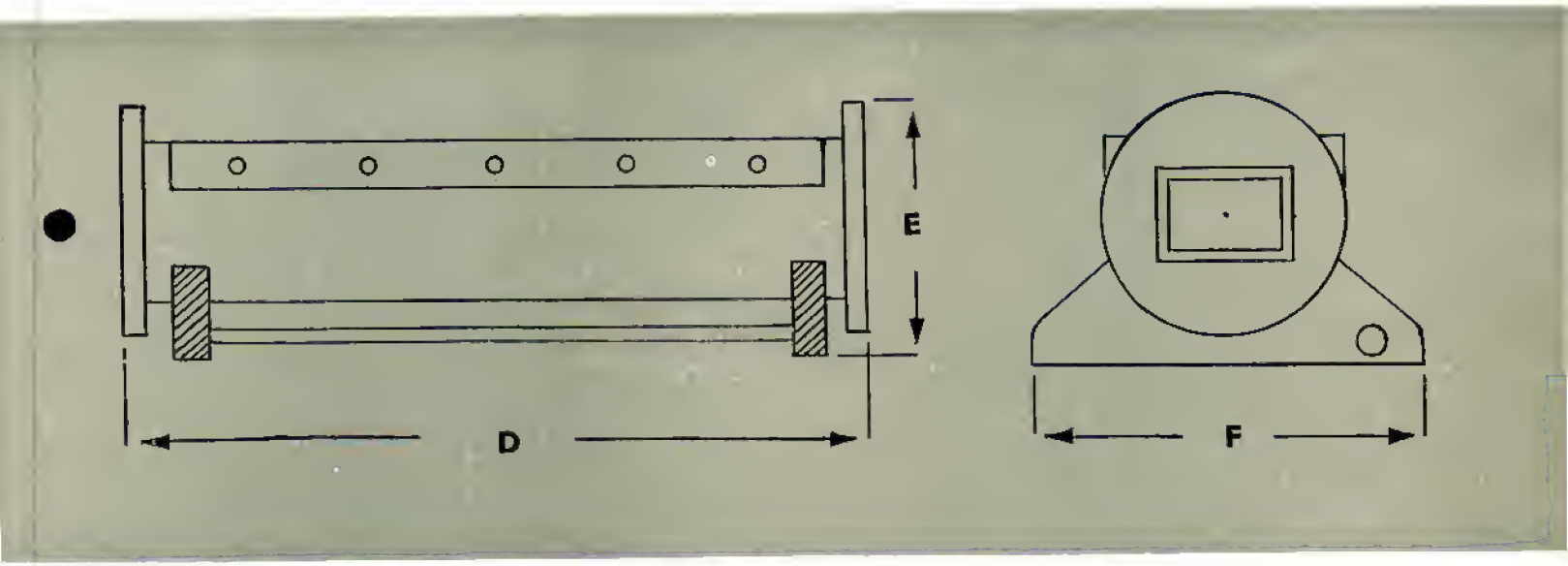
SPECIFICATIONS continued

B. Slotted Sections



Wave Guide Size	Type No.	Atten. Slope*	Material	Wave Guide impedance relative to nominal guide	Frequency range in kMc/s	Dimensions D	Dimensions E	Dimensions F	Weight	Flange
16	WS 16	Zero	Aluminium	Within 0.1%	8.0-12.4	11¼" 285.7 mm.	3" 76.2mm.	4⅝" 120.7 mm.	5lb. appx. 2.27 kgrm.	Z830003
15	WS 15	Zero	Aluminium	Within 0.1%	7.0-10.5	11¼" 285.7 mm.	3" 76.2mm.	4¾" 120.7 mm.	6lb. appx. 2.72 kgrm.	Z830034
14	WS 14	Zero	Aluminium	Within 0.1%	5.85-8.2	14¾" 374.6 mm.	3½" 88.9mm.	4¾" 120.7 mm.	8lb. appx. 3.63 kgrm.	Z830038
12	WS 12	Zero	Aluminium	Within 0.1%	3.95-5.85	17½" 444.5 mm.	3¾" 95.3 mm.	4¾" 120.7 mm	12lb. appx. 5.44 kgrm.	Z830042
10	WS 10	Zero	Aluminium	Within 0.1%	2.5-3.95	21½" 546 mm.	5¼" 133.4 mm.	4¾" 120.7 mm.	16lb. appx. 7.26 kgrm.	Z830010

* Zero slope is achieved by adjusting the carriage guide-bars as part of the electrical test procedure.

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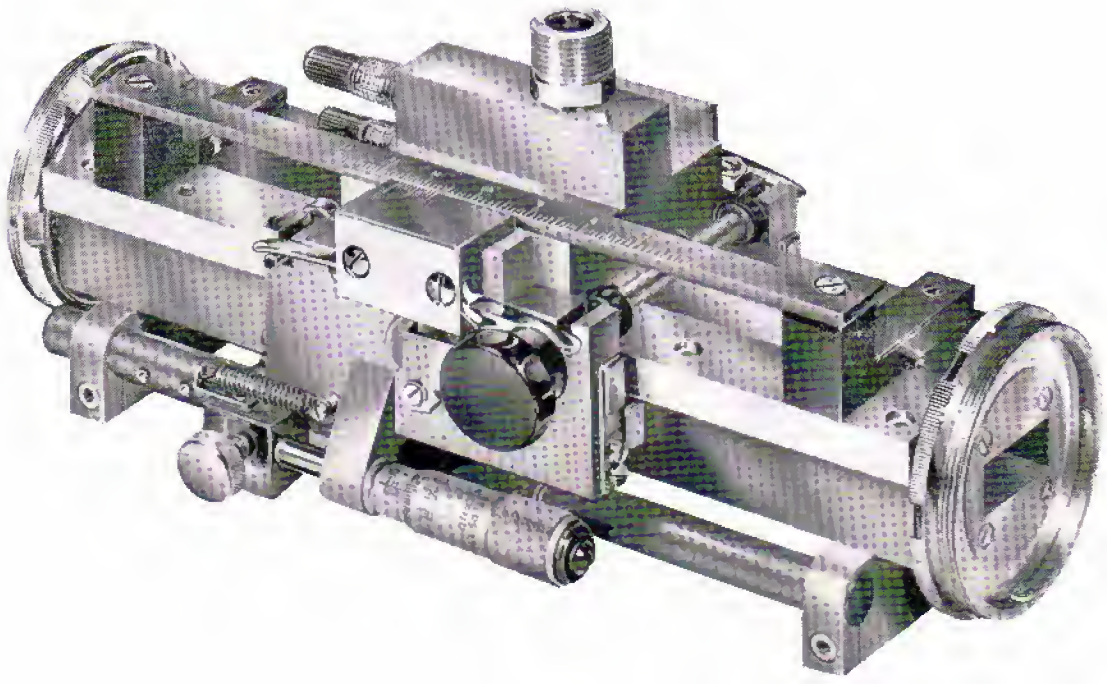
Sanders

standing wave meters

Grade 1

section S



These instruments are designed to achieve an absolute accuracy of measurement of better than 0.5% impedance over the frequency range of the waveguide.

The waveguide is formed from a channel section, and a flat top plate extends beyond the outside surface of the channel section providing a reference surface for location of the carriage and probe assembly. Great care is taken to avoid the danger of distortion as the structure ages, a series of stress relieving processes being applied during manufacture.

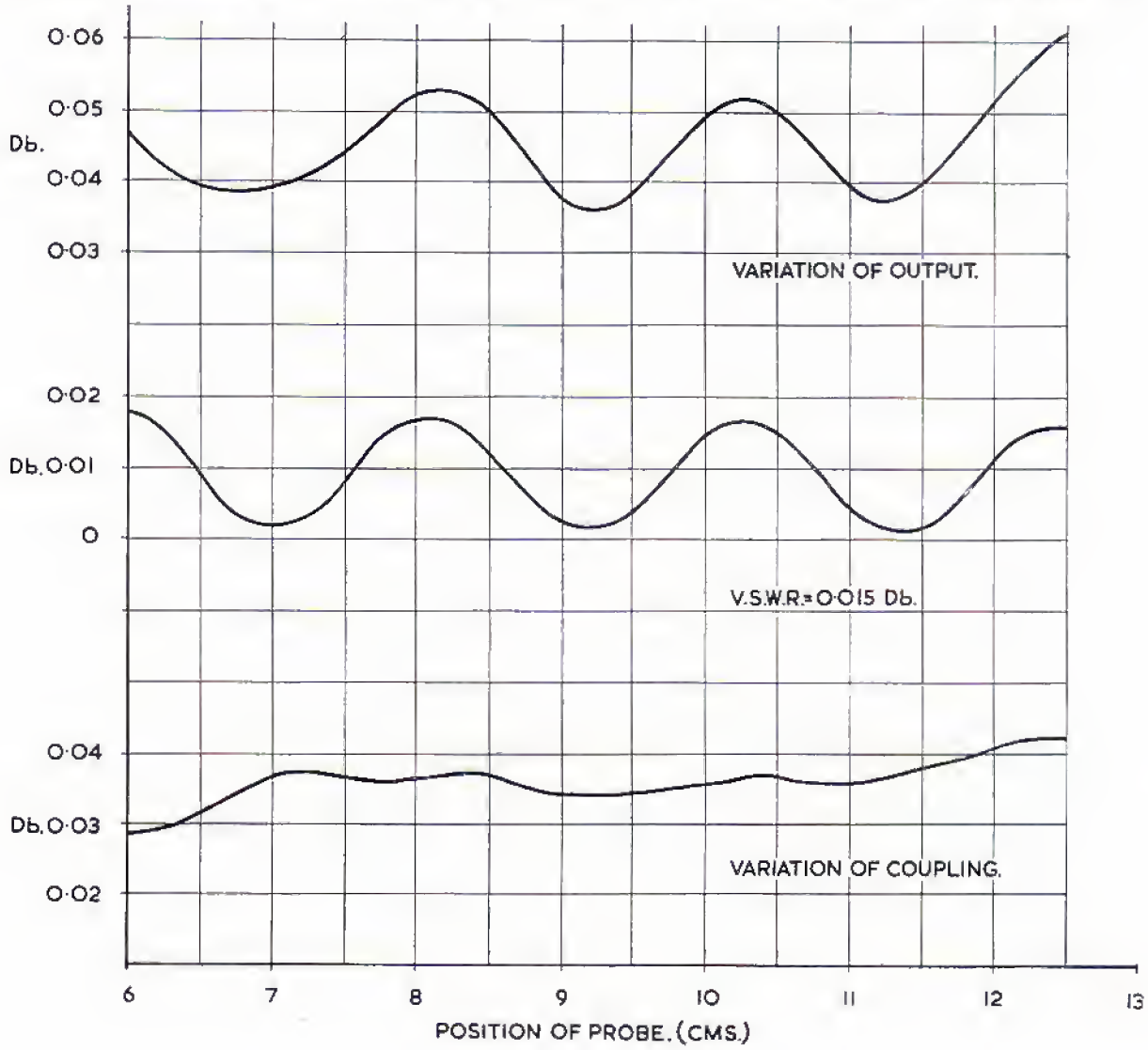
The carriage is located according to kinematic principles by means of five rollers. Its position along the axis of the guide is accurately established by means of a scale bar, sliding stop and micrometer. The sliding stop is so arranged that it may be located on the scale bar at precisely defined intervals of 1 c.m., the micrometer attached to the carriage

standing wave meters

serving to interpolate between these points to an accuracy of 0.001 cms. When phase measurements are not required to this accuracy, this mechanism may be disconnected and the carriage may be rapidly moved by means of a simple friction drive. The position of the carriage is then indicated by means of a vernier and scale to an accuracy of 0.005 cms.

The instrument is designed to provide R.F. output on a type N coaxial connector. Alternatively, by using a coaxial crystal detector, Type CDN/C or CDN/S (which is supplied separately), rectified output may be obtained. The probe length is fixed and the coupling to the waveguide is about 23 db. The coupling varies only slightly as a function of frequency, due to the fact that two reactive tuning stubs are provided in order to match the output to the probe. It is, therefore, impossible to create serious errors in measurement by maladjustment of the probe circuit, and under no conditions of adjustment will the reflection from the probe exceed 0.01. Faulty setting of the tuning stubs merely results in a loss of coupling to the waveguide and a reduction of reflections from the probe

TYPICAL PERFORMANCE GRAPH OF A WAVEGUIDE 16 STANDING WAVE METER SWM 16/1



Typical Calibration Certificate of a Waveguide 16

STANDING WAVE METER SWM.16/1

(frequency 9456 mc/s λg = 4.400 cms)

1. Coupling of Travelling detector: 21.8 db.

2. Variation of coupling and impedance measurement.

Position of probe (cms)	Variation of output (db)	Variation of Coupling (db)
6.0	0.046	0.029
6.5	0.040	0.031
7.0	0.040	0.037
7.5	0.045	0.037
8.0	0.054	0.037
8.5	0.051	0.038
9.0	0.039	0.035
9.5	0.040	0.035
10.0	0.051	0.036
10.5	0.053	0.037
11.0	0.043	0.036
11.5	0.041	0.038
12.0	0.053	0.041
12.5	0.061	0.043
13.0		

V.S.W.R. 0.015 db

The above table gives the output as a function of position of the travelling detector. In this test the instrument is terminated with a standard waveguide containing a matched termination. The reflection from the termination has been eliminated by the measurement technique so that the second column of figures represent the variation of output which would be observed when measuring a standard perfectly terminated guide. The V.S.W.R. is extracted by graphical analysis from this result and the figure stated is a measure of the error in impedance measurement in the instrument. The third column represents the variation of coupling of the travelling detector to a pure travelling wave. This information can be used to improve the accuracy of measurement if desired.

For further information see Journal of the Brit. I.R.E. Vol. 15. No. 11. Nov. 1955. pages 539-564.

3. Short circuit test.

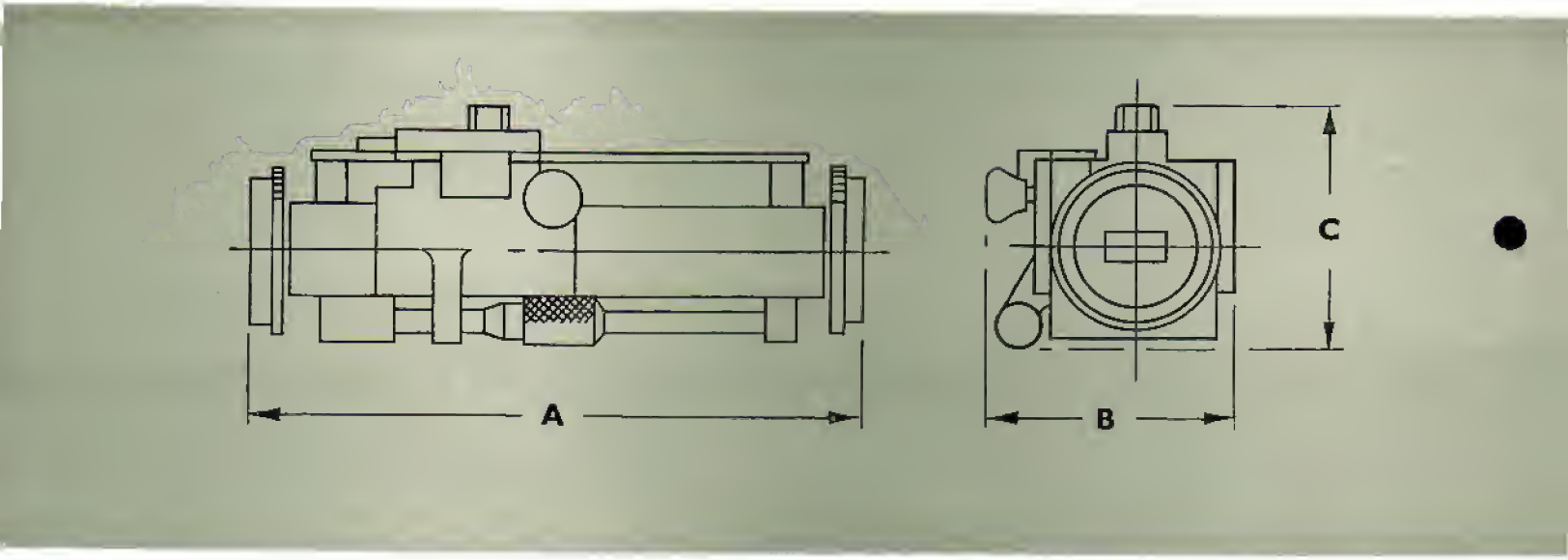
   (a) Scale bar set up at 6.600 cms.

   (b) V.S.W.R. nearest S/C: 50.55 db.
   V.S.W.R. furthest from S/C: 50.10 db.

   (c) Attenuation constant α: 0.00020 nepers/cm.

   (d) Phase constant $\frac{(2\pi)}{(\lambda g)} = \beta$: 1.428 radians/cm.

specifications



Type No.	WG 18	WG 16	WG 15
Frequency Range in Km/cs.	12.0-18.0	8.2-12.0	7.0-10.5Kmc/s
Waveguide Impedance	Within 0.1% of nominal	Within 0.1% of nominal	Within 0.1% of nominal
End of slot reflection	Less than 0.001 voltage refl. coefficient	Less than 0.001 voltage refl. coefficient	Less than 0.001 voltage refl. coefficient
Attenuation of Slotted Section in nepers/Cm.	0.0005	0.0003	0.0003
Probe discontinuity	Less than 0.01 voltage refl. coefficient	Less than 0.01 voltage refl. coefficient	Less than 0.01 voltage refl. coefficient
Coupling of probe in db	20-23	20-23	20-23
Variation of coupling over full length of travel in db	Less than 0.02	Less than 0.02	Less than 0.02
Mechanical reset accuracy in cms.	0.005	0.001	0.001
Mechanical measurement of length at any interval in cms.	Better than 0.01	Better than 0.002	Better than 0.002
Accuracy of Electrical Angle.			
(a) Without correction for slot disturbance	0.1 radian	0.02 radian	0.02 radian
(b) With correction for slot disturbance	0.01 radian	0.002 radian	0.002 radian
Dimensions:			
A	$6\frac{1}{4}$" (158.75mm.)	$8\frac{1}{4}$" (209.5mm.)	9" (228.6mm.)
B	$3\frac{3}{4}$" (95.25mm.)	$3\frac{7}{8}$" (98.4mm.)	$4\frac{1}{4}$" (107.9mm.)
C	$2\frac{7}{8}$" (69.85mm.)	$3\frac{5}{8}$" (92.1mm.)	$3\frac{11}{16}$" (93.7mm.)
Finish	Nickel with a Rhodium flash. Internal surfaces, copper plate, gold flash	Nickel with a Rhodium flash. Internal surfaces, copper plate, gold flash	Nickel with a Rhodium flash. Internal surfaces, copper plate, gold flash
Weight	3lb. (1.36Kgm.)	7lb. 15oz. (3.6Kgm.)	7lb. $7\frac{1}{2}$ozs. (3.3Kgm.)
Flanges	Z830030	Z830004	Z830034

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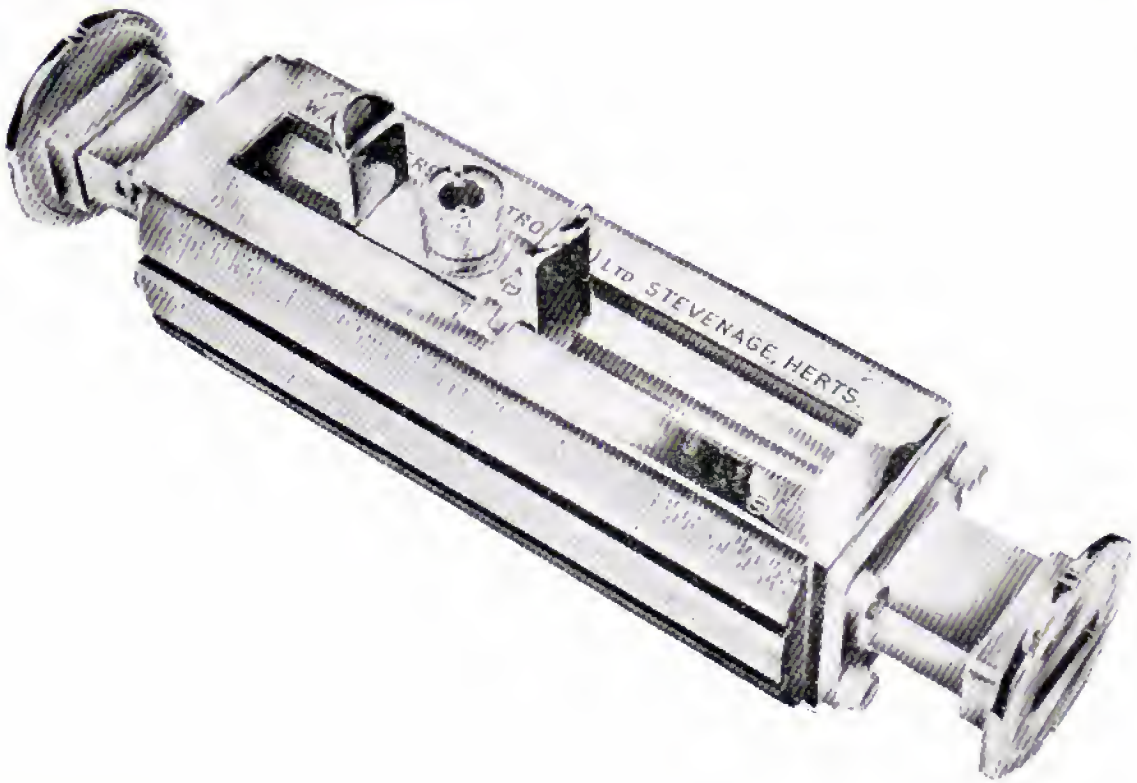
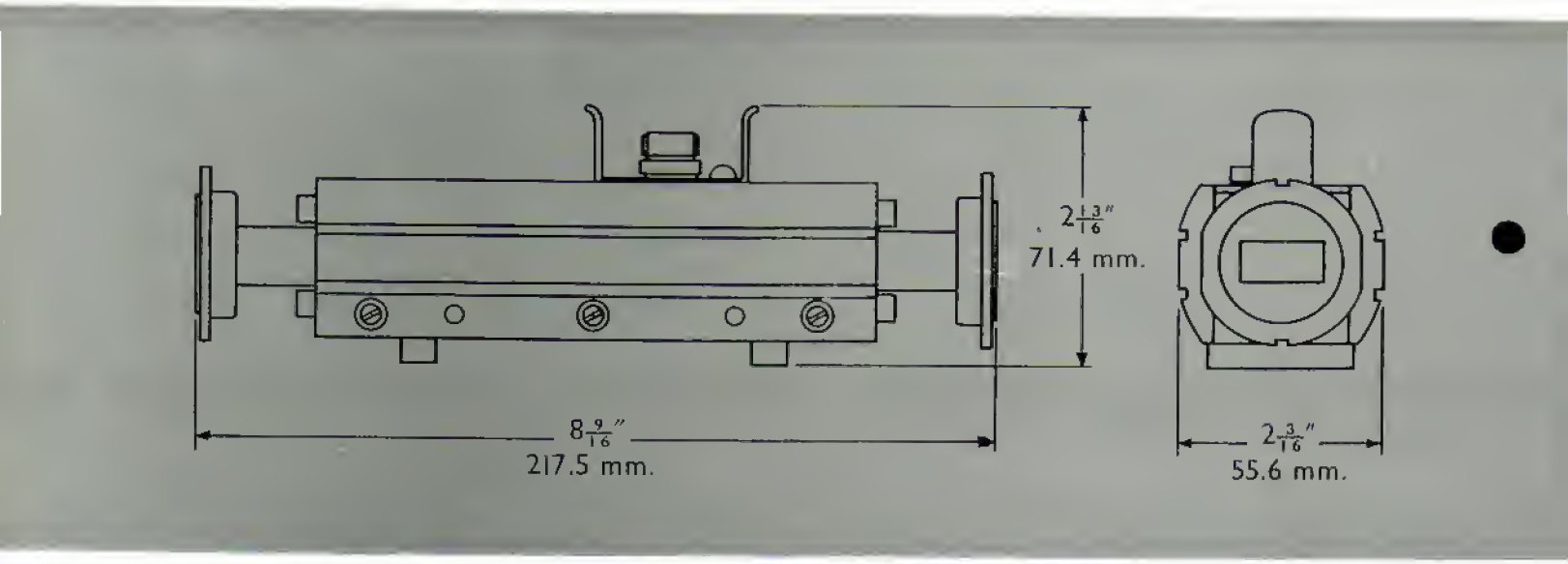
standing wave meter
SWM. 16/2



This standing wave meter has been designed from an economic viewpoint to provide a general purpose instrument at low cost. It has a probe carriage located according to kinematic principles in a V-groove with an R.F. output on a type N coaxial connector, which may be rectified by using a coaxial crystal detector, similar to the type CDN/S.

The position of the probe with respect to the terminal coupling is indicated by a graticule on a scale with an accuracy of better than ± 1.0% of the guide wavelength. The voltage reflection coefficient of the probe is about 0.01 and the coupling to the waveguide about 23 db. Coupling variations of the probe along the whole length of travel due to mechanical misalignment is less than 0.05 db. The probe penetration is fixed and has a wide band coupling characteristic thereby obviating any need for tuning and allowing more rapid measurements to be taken. This instrument is therefore suitable for production testing, demonstration purposes and development laboratory measurements that do not need extremely high accuracies.

specifications



Frequency Range:	8.2 to 12.5 kMc/s.
Attenuation Slope:	About 0.005 db/cm.
Probe discontinuity:	Less than 0.01 VRC.
Coupling of probe:	23 db ± 1.5 db over the frequency range.
Variation of coupling over length:	0.05 db.
Mechanical reset accuracy:	0.01 cm.
Finish:	Body—light grey stove enamel, hammer finish. Waveguide ends: Rhodium flash.
Flanges:	Z830004 both ends. Alternate flange combinations fitted to order. For details see flange data sheet.
Weight:	5 lb. 12 ozs. 2.6 kgrm.

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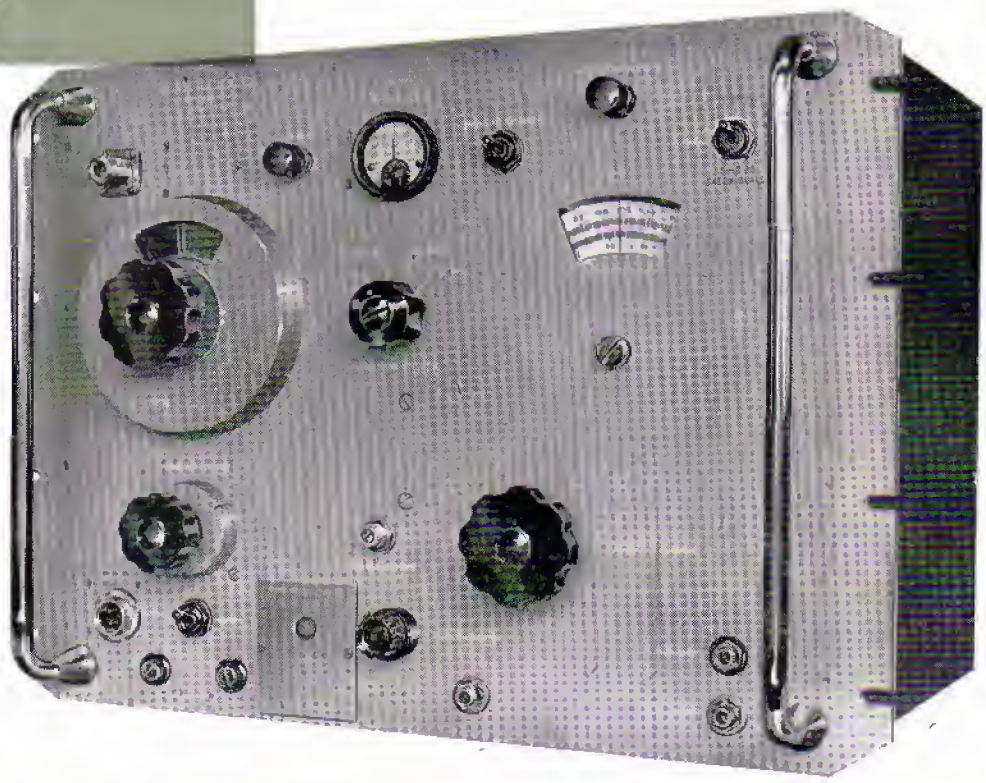
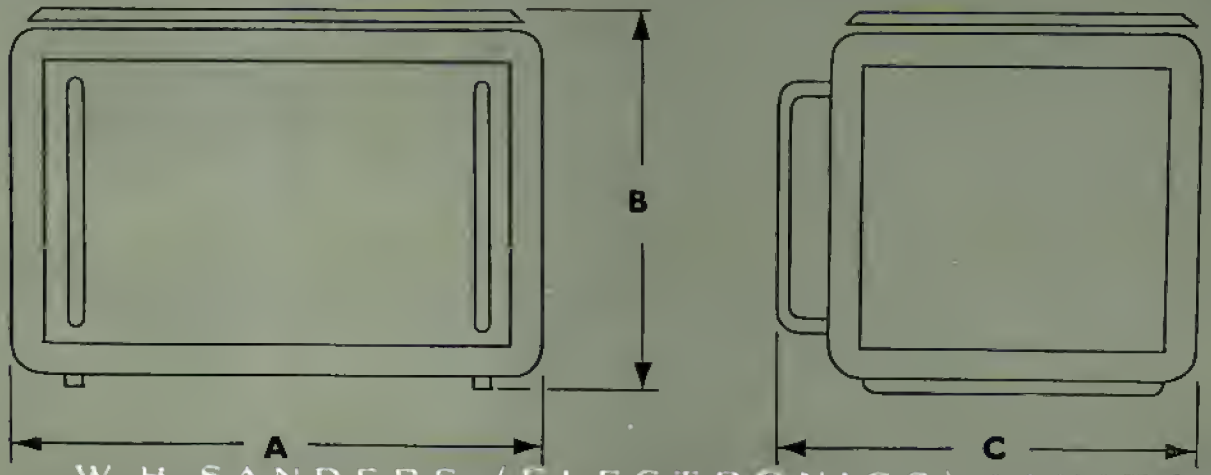
signal generators

CT 312



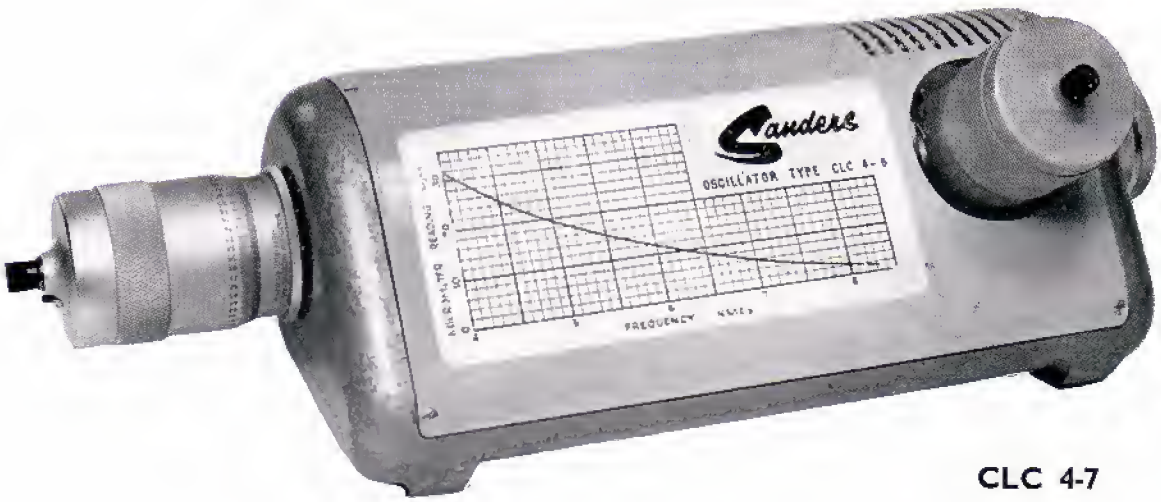
Signal generators CT312, CT313, and CT314 cover the frequency range 1.3 kMc/s to 12.0 kMc/s in three steps: 1.3-4.2 kMc/s, 4.0-7.0 kMc/s, 7.0-12.0 kMc/s. In all other respects they are similar in basic design. Each generator comprises a klystron oscillator in a coaxial resonant cavity fed from a stable power source which has provision for the application of square wave or pulse modulation from internal or external sources. An internal RF power monitor establishes a power level of 1 milliwatt at the output of a piston attenuator when that attenuator is set at zero. It is then calibrated from 0 db to 100 db below the milliwatt. In each instance the generator is a front panel assembly on which the RF circuit is located together with all the controls and indicators necessary for the operation of the instrument, and a circuit chassis mounted on pillars behind and parallel to the front panel. The front panel is drilled for mounting in a standard 19" rack and the whole generator is protected by a dust cover which has been designed to provide adequate ventilation. The front panel is protected during transit by a removable lid which also houses the various connectors and leads for the signal generator.



Type No.	CT 312	CT 313	CT 314
Power Supply			
Voltage	110, 115, 120, 180, 200, 210, 220, 230, 240 and 250 V	110, 115, 120, 180, 200, 210, 220, 230, 240 and 250 V	110, 115, 120, 180, 200, 210, 220, 230, 240 and 250 V
Frequency	50 to 500 c/s	50 to 500 c/s	50 to 500 c/s
Power consumption	approx. 200 W.	approx. 200 W.	approx. 200 W.
Frequency			
Coverage	1300 to 4200 Mc/s in two bands 1300 to 2200 Mc/s 2100 to 4200 Mc/s	4000 to 7000 Mc/s	7000 to 12000 Mc/s
Accuracy	±.25% at 18°C from 2100 to 4200 Mc/s ±1% at 18°C from 1300 to 2100 Mc/s	±0.1% at 18°C	±0.1% at 18°C
Variation with temperature	1% from 0 to 40°C	0.2% from 0 to 40°C	0.2% from 0 to 40°C
Short Term Stability	better than 1 in 10^5	better than 1 in 10^5	better than 1 in 10^5
Power Output			
Nominal level	1mW	1mW	1mW
Attenuation	0 to − 100 dbm	0 to − 100 dbm	0 to − 100 dbm 0 to + 10 dbm over limited band
Maximum power output	approx. 20 mW	approx. 10 mW	approx. 10 mW
Accuracy of 1 mW level	±2.5 db	±2 db	±2 db from 8000 to 11000
Incremental accuracy	±(0.2 db+1%)	±(0.2 db+1%)	±(0.2 db+1%)
Long term stability	0.5 db	0.5 db	0.5 db
Output termination	50 ohm Type N Socket	50 ohm Type N Socket	50 ohm Type N Socket
Leakage	less than 90 db	less than 90 db	less than 90 db
Modulation			
Internal Squarewave			
Percentage modulation	100%	100%	100%
Frequency	2700 to 3300 c/s	2700 to 3300 c/s	2700 to 3300 c/s
Mark-space ratio	0.95 to 1.05	0.95 to 1.05	0.95 to 1.05
Rise and fall time of R.F. output	less than 0.2 usec	less than 0.2 usec	less than 0.2 usec
Sync output	10 V	10 V	10 V
Internal pulse			
Percentage modulation	100%	100%	100%
Frequency	2700 to 3300 c/s	2700 to 3300 c/s	2700 to 3300 c/s
Rise and fall time of R.F. pulse	less than 0.2 usec	less than 0.2 usec	less than 0.2 usec
Pulse width at half amplitude	1 to 2 usec	1 to 2 usec	1 to 2 usec
Sync. output	+5 V	+5 V	+5 V
External Pulse			
Input: Amplitude	5 volts positive	5 volts positive	5 volts positive
Width	0.1 usec minimum	0.1 usec minimum	0.1 usec minimum
Frequency	100 to 250000 c/s	100 to 250000 c/s	100 to 250000 c/s
R.F. output pulse: Width	approx. 0.7 usec	approx. 0.7 usec	approx. 0.7 usec
Rise time	0.1 usec	0.1 usec	0.1 usec
Delay on trigger (a) with 1 usec input pulse	approx. 0.5 usec	approx. 0.5 usec	approx. 0.5 usec
(b) with 0.1 usec input pulse	approx. 0.3 usec	approx. 0.3 usec 0.1 usec	approx. 0.3 usec 0.1 usec
Dimensions			
A	19" 482.6 mm.	19" 482.6 mm.	19" 482.6 mm.
B	14" 355.6 mm.	14" 355.6 mm.	14" 355.6 mm.
C	15" 381 mm.	15" 381 mm.	15" 381 mm.
Weight	58lb. 26.3 kgrm.	63lb. 28.6 kgrm.	63lb. 28.6 kgrm.
Finish	BS 381C Light Grey	BS 381C Light Grey	BS 381C Light Grey

NOTE : With an external pulse modulation of width less than 1 usec, the R.F. output may not be obtained over whole frequency band due to the delayed start of oscillation of the Klystron.

coaxial line oscillators



CLC 4-7

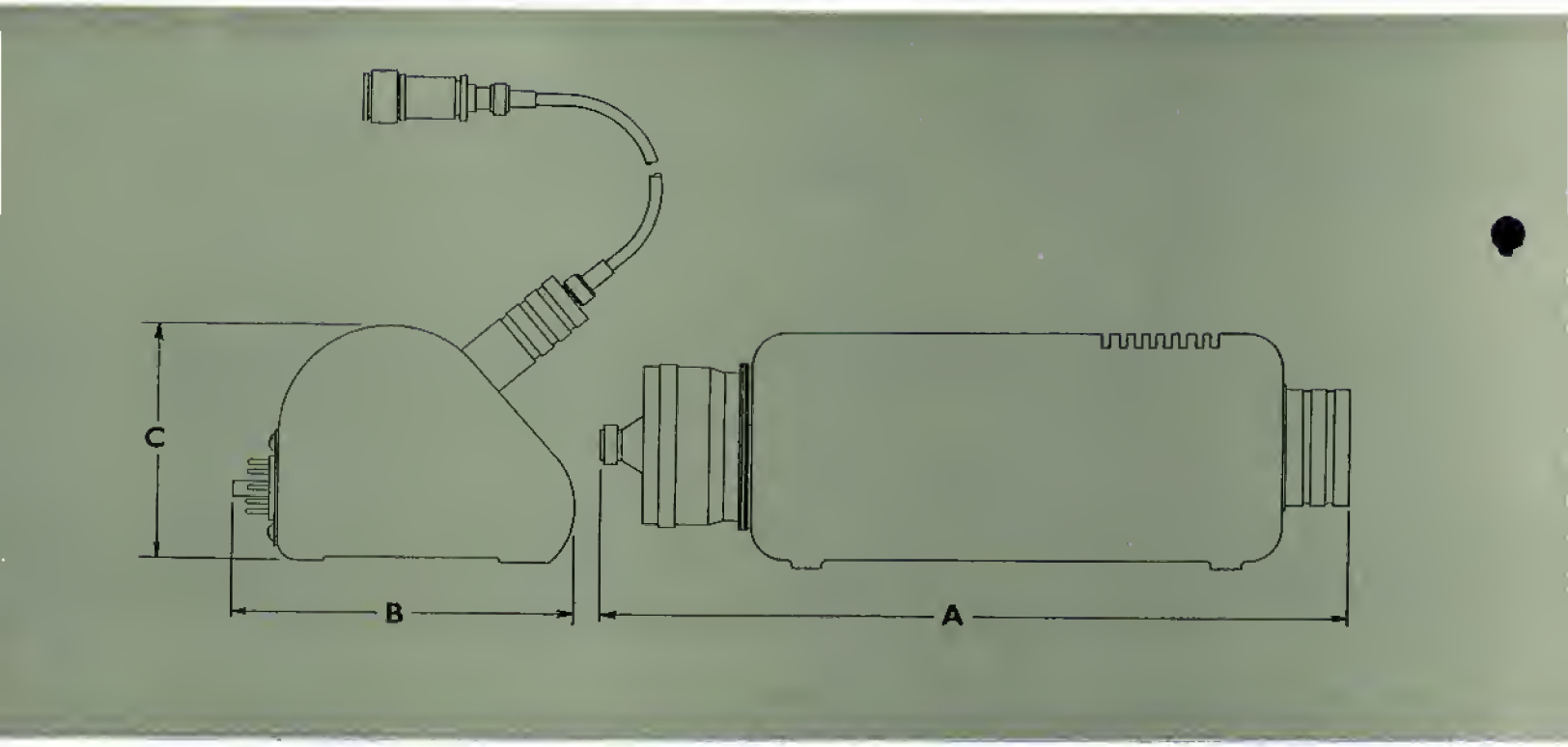
These oscillators employ low voltage plug in klystrons in coaxial line cavities to cover the frequency range 1.3 kMc/s to 12.0 kMc/s in three sections. The details of frequency coverage and type number are shown in the specifications.

Each oscillator is adjustable continuously over its frequency range by means of a mechanical system which has been designed to have a high reset accuracy and no backlash. An approximate calibration of the movement against frequency is provided by a graph on the front panel of the instrument, but as each instrument is usually supplied with the valve fitted an individual calibration of the system is supplied to an accuracy of $\pm 0.1\%$

Cessation of oscillation and mode hysteresis have been eliminated by ensuring a positive contact between the valve and the cavity and by using an anodised aluminium non-contacting plunger to vary the cavity size, which is one half a wavelength long. The contacts are designed so that valves can be changed easily and oscillation obtained over the whole frequency range. After an initial warm up period of about 20 minutes the frequency stability is better than 1 part in 10^6.

The R.F. output is taken through an uncalibrated set-level piston attenuator into an 18-in. length of 50 ohm coaxial cable terminated by a type N coaxial plug. This allows the oscillators to be coupled to any waveguide size by using a coaxial-to-waveguide transformer similar to the X16/C.

specifications



Type No.	Valve Used	Frequency Range in kMc/s	Reset Accuracy in Mc/s	Calibration Accuracy	Variation Power Output at N Plug in mW.	DIMENSION A	DIMENSION B	DIMENSION C	Weight
CLC 7-12	CV2346	7 to 12	better than ± ¼	0.1%	20 to 5	12" 30.5 mm.	5¼" 13.3 mm.	5" 12.7 mm.	9lb. 3oz. 4.17 kgrm.
CLC 4-7	CV2346	4 to 7	better than ± ¾	0.1%	20 to 5	15"* 38 mm.	8¼"* 20.8 mm.	8"* 20.3 mm.	12lb.* 5.44 kgrm.
CLC 2-4	CV2116	1.3 to 4.5	better than ± ¾	0.1%	† 20 to 5	20" 50.8 mm.	8¼" 20.8 mm.	8" 20.3 mm.	16lb. appx. 7.3 kgrm

Finish: (a) Case—Light grey stove enamel hammer.
(b) Front Panel—Light grey BS381C tint 631.

† This is a minimum figure. Details of final test figures will be published shortly.

* These dimensions may be subject to slight alteration in the future.

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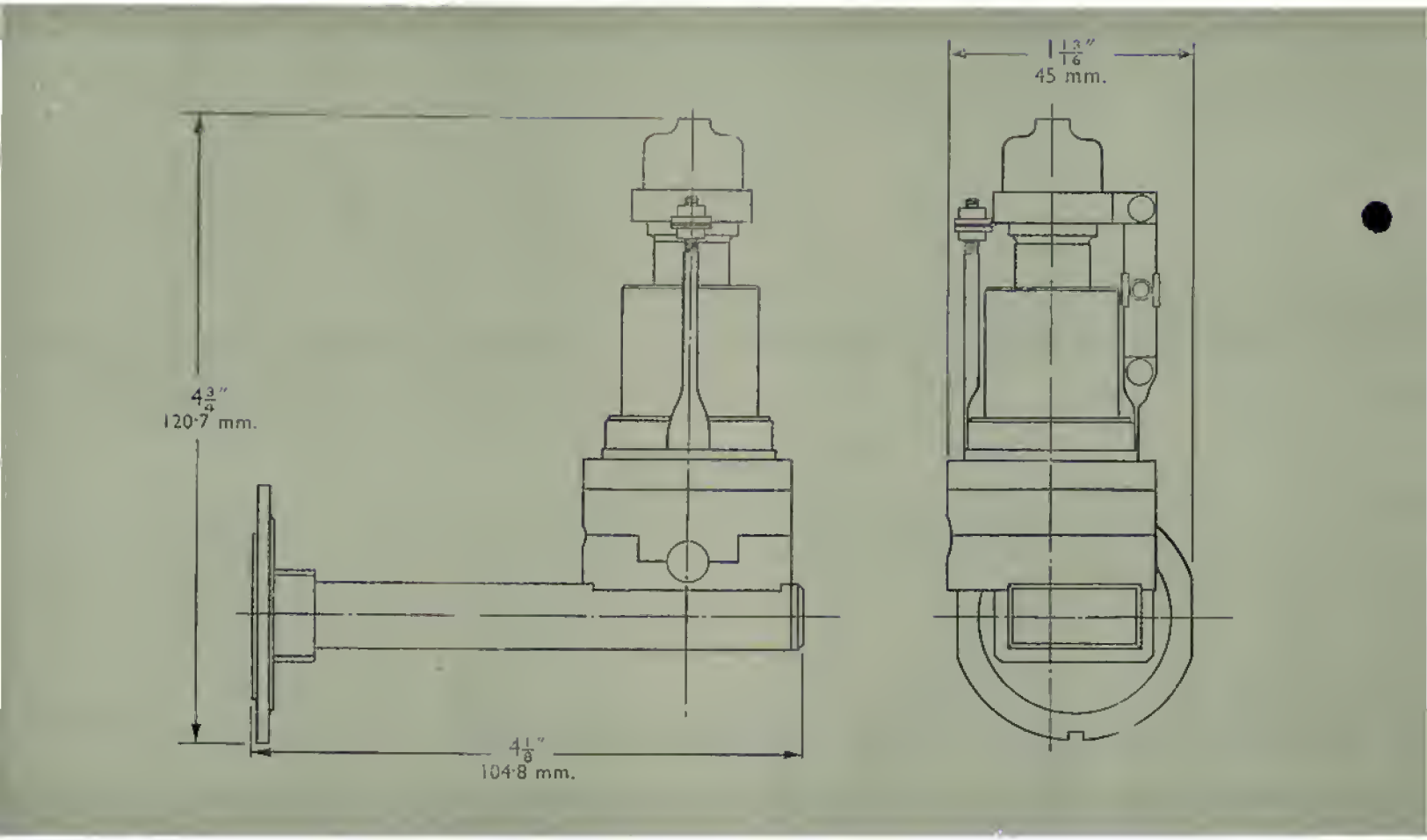
klystron mount KM.723

This component consists of a short-circuited section of waveguide size 16 fitted with a mount to support a valve base which is wired for use with klystron type 723 AB. (CV 1795). Connections from the base are brought out into a 3 ft. length of cable, which is terminated with an octal plug.

The position of the klystron probe with respect to the short circuit is arranged to give optimum performance over the frequency range 8.5 to 9.5 kMc/s.

specifications



PERFORMANCE

Frequency coverage:	8.5—9.5 kMc/s.
Finish:	Grade I Instrument finish
Flange:	Z830004. Alternative flanges can be fitted to order, for details see flange data sheet.

Weight without cable or klystron: 12 oz. (340 grms.)

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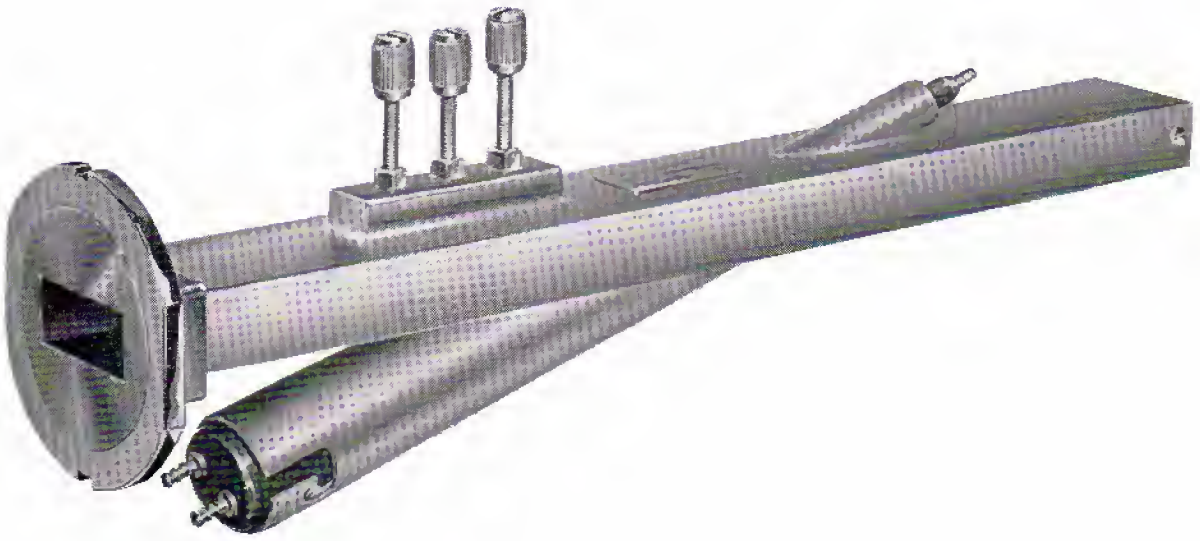
noise source units



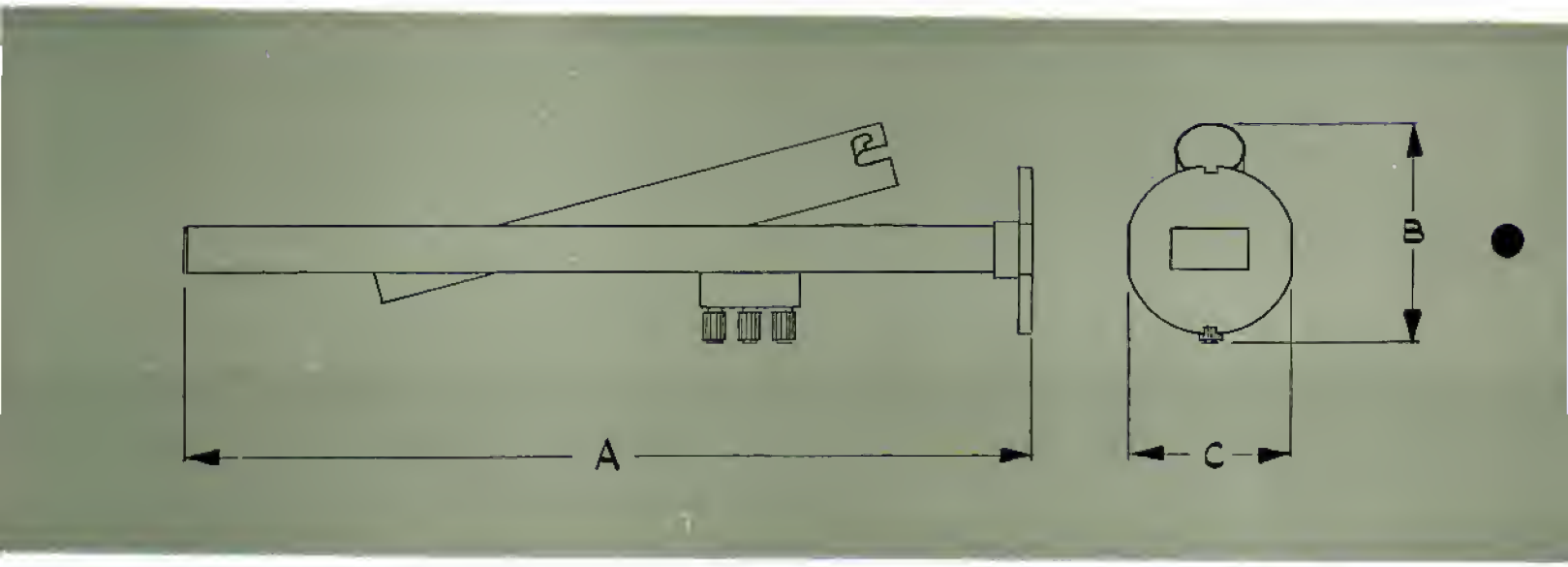
This noise source consists of a CV2479, housed in a metal shield, and orientated at an angle of 15° to the waveguide axis in the E Plane.

The tube is an improvement over types previously offered, having better electrical and mechanical characteristics. A short matched termination behind the tube effectively absorbs the backward radiation over the frequency range of the waveguide, this ensures a constant impedance with the tube in the energised or extinguished state.

This is important, as the noise factor of a crystal mixer is critically dependent upon the impedance presented to it. By this method, measurement techniques are simplified, and the possibility of errors reduced.

A three stub tuner is provided to match the mount, with the diode struck, to a VSWR of better than 0.97:1 at a frequency of 9375 mc/s. This provides a VSWR of better than 0.8:1 from 9025 mc/s to 9726 mc/s.

specifications



Wave Guide Size	Type No.	Noise Tube	V.S.W.R.	Frequency Range	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges normally fitted
WG 16	N.S. 16 Mk. II	CV 2479	0.8: 1	9025/9726 mc/s	$9\frac{5}{8}$" 244.5 mm.	$2\frac{1}{2}$" 63.5 mm.	$1\frac{3}{4}$" 44.5 mm.	12ozs. 341 grm.	Z830004

Finish : Grade I Instrument Finish.

For details see flange data sheet.
Alternative flanges can be supplied to order.

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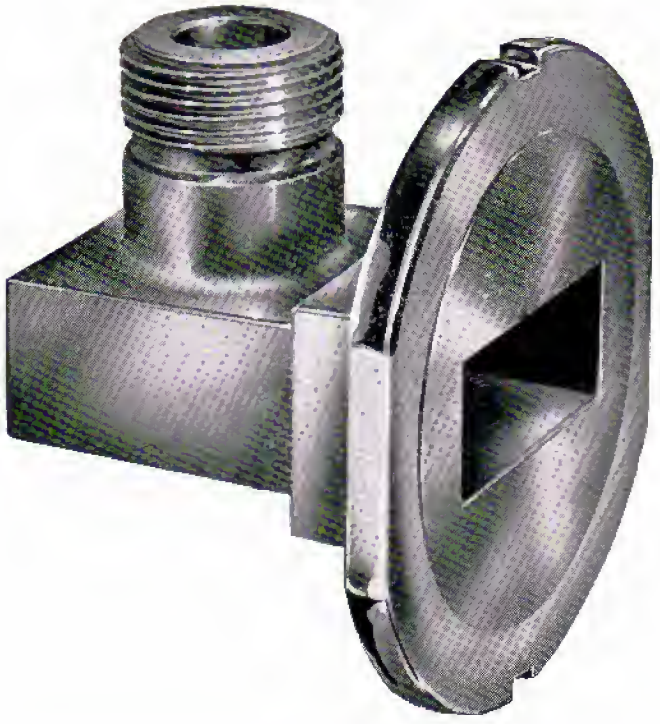
coaxial to waveguide transformer



X16 C

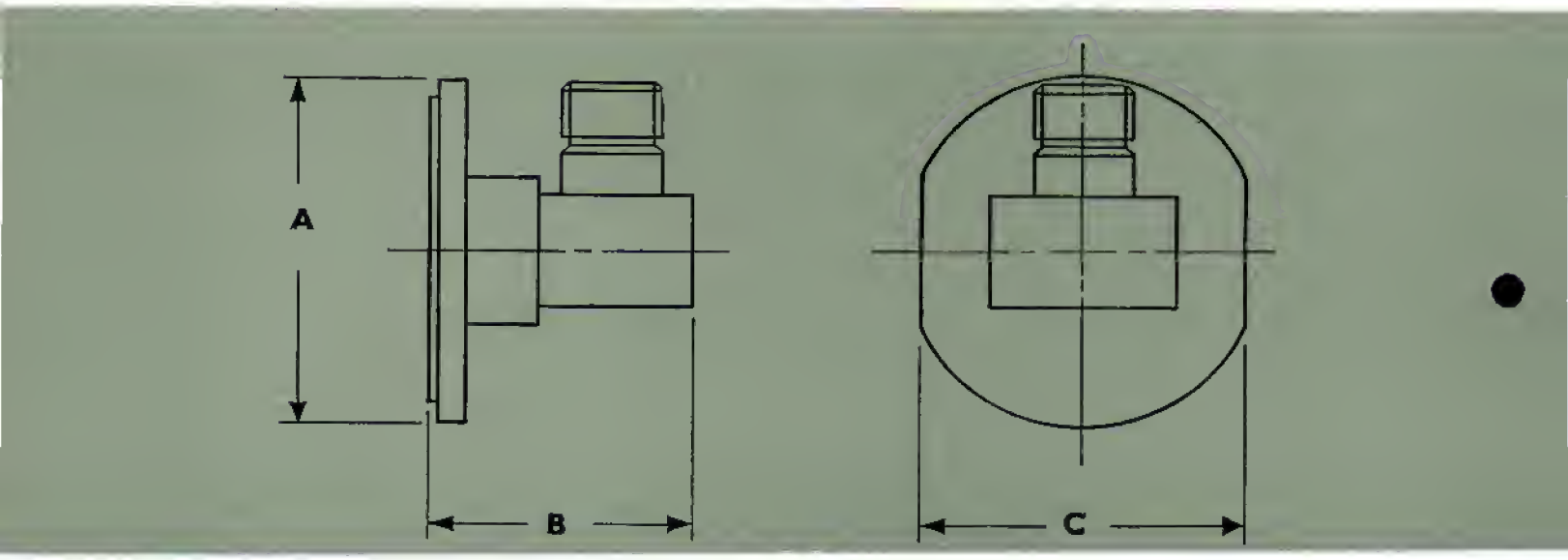
This transformer provides a convenient means of transmission between waveguide and coaxial systems over the range of operation of the waveguide size.

It consists of a short length of coaxial line mounted perpendicular to the broad face of a shorted waveguide section. The centre conductor of the coaxial line extends as a probe into the waveguide and is connected at its end to a bar at right angles to the probe. The ends of this bar are connected to the narrow faces of the waveguide.

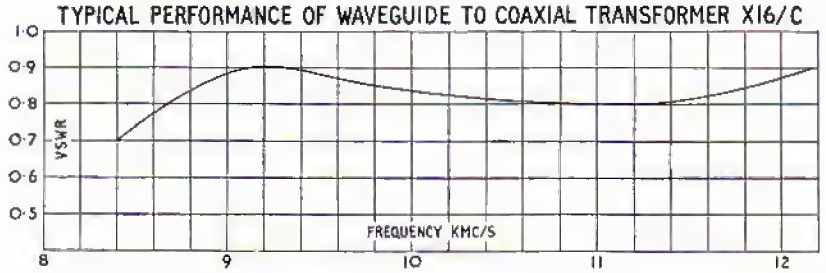
The coupling between the waveguide and the coaxial sections is carefully designed to provide a V.S.W.R. of better than 0·8 : 1 over a wide frequency range. A typical graph of the variation of mismatch with frequency is shown. This results in a minimum disturbance of the properties of the components connected to the transformer. No dielectric materials are used which leads to a negligible insertion loss.

The transformer is fitted with a standard type N plug for connection to the coaxial cable, and a plain flange for connection to waveguide components.

specifications



TYPICAL PERFORMANCE OF WAVEGUIDE TO COAXIAL TRANSFORMER X16/C



Wave Guide Size	Type No.	Frequency Range in kMc/s	V.S.W.R.	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges*
WG 18	X18/C	12.0–18.0	0.75:1	$1\frac{1}{2}$" 38.1 mm.	$1\frac{5}{16}$" 33.3 mm.	$1\frac{5}{16}$" 33.3 mm.	3 oz. 75 gm.	Z830038
WG 16	X16/C	8.5–12.0	0.75:1	$1\frac{7}{8}$" 47.7 mm.	$1\frac{3}{8}$" 34.9 mm.	$1\frac{3}{4}$" 44.4 mm.	4 oz. 113.4 gm.	Z830004
WG 15	X15/C	7.0–10.0	0.75:1	$1\frac{7}{8}$" 47.7 mm.	$1\frac{11}{16}$" 43 mm.	$1\frac{7}{8}$" 47.7 mm.	6 ox. 170.1 gm.	Z830034
WG 14		Under Development		Available Shortly.				
WG 12		Under Development						

Finish: Grade I Instrument Finish

*Flanges: Alternative British or American flanges fitted to order
Details of these flanges shown on flange data sheet

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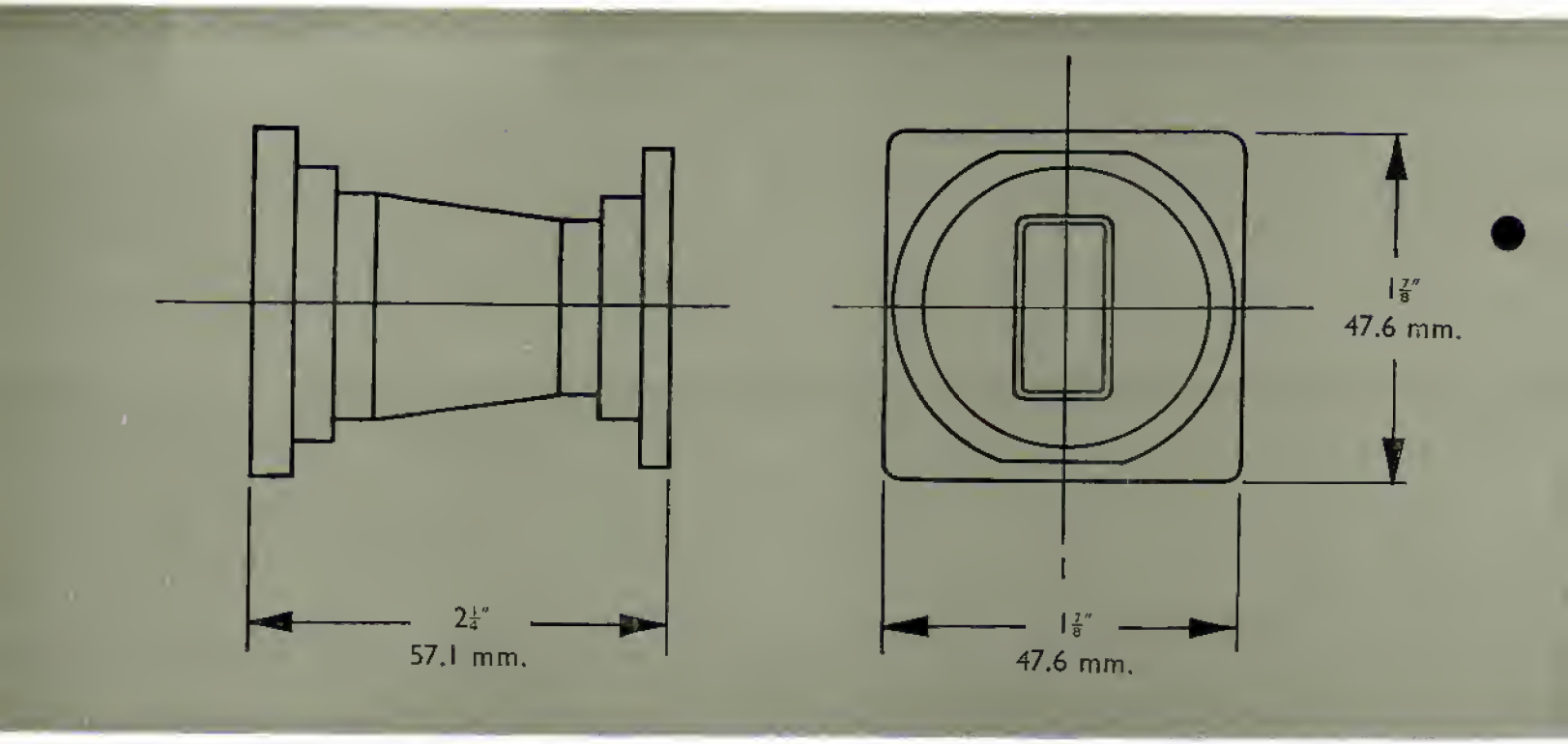
section XT

taper transformer XT.15/16

This component provides a taper transition from waveguide size 15 to 16. It is produced by an electro forming process enabling internal dimensions and length of taper to be held to very close limits.

Taper transitions between other waveguide sizes are available on request.

specifications



PERFORMANCE

V.S.W.R.: Better than .96 over the frequency band 8.5-10 kMc/s.

Flanges: Waveguide 15 Square type Z830034
to Waveguide 16 Round type Z830004
or Square type Z830052.

Finish: Grade I B.S.1. Instrument Finish.

Weight: 8 oz. (226.8 grm.).

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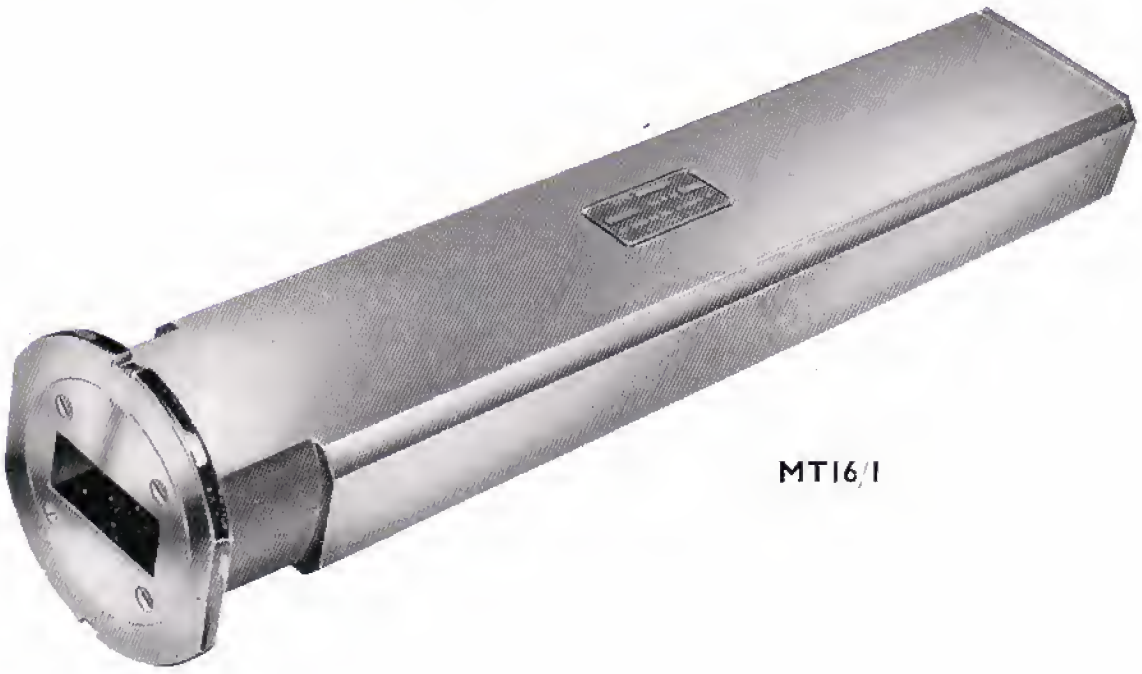
matched terminations

GRADE 1.



MT16/1

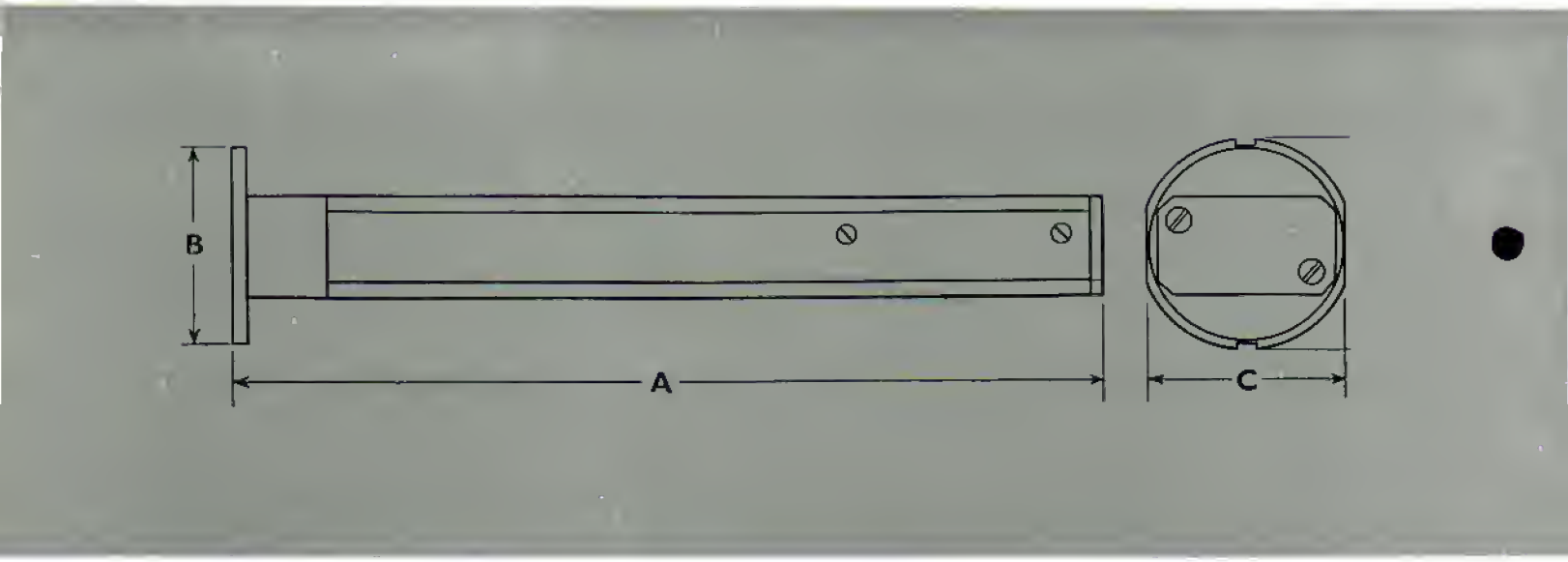
One of the primary requirements in a laboratory measuring bench is a termination which has a negligibly small voltage reflection coefficient. To this end considerable care has been taken in design and manufacture to ensure that adequate tolerances are achieved in all critical parameters.

The dissipative material is made of an air-curing resin loaded homogeneously with a finely divided iron powder. The shape has been chosen so as to introduce it very gradually to the travelling wave in the guide with a small initial discontinuity. The high absorptive power of the material allows the overall length of the termination to be kept to a reasonable value.

The voltage reflection coefficient of the wedge is extremely small and at this order the contribution of waveguide aperture dimensions and characteristic impedance at the coupling plane to the total reflection coefficient is significant. This aperture is controlled to ensure that it is rectangular and close to the nominal dimensions of the guide by electroforming the body. This also ensures that any changes in guide cross-section take place gradually. The plain flange is located on this body by means of a jig ensuring accurate location and is machined accurately flat to make a butt joint with a similar plain flange, the contact being left unplated to facilitate periodical cleaning.

The overall V.S.W.R. obtainable over the frequency range of the waveguide size is 0.995 ; 1.

specifications



Waveguide Size	Type No.	Frequency Coverage in kMc/s	V.S.W.R.	Mean Power Handling Capacity	Dimensions A	B	C	Flanges	Weight
18	MT 18/1	12.4-18	0.995: 1	1 watt	6″ 152.4 mm.	$1\frac{5}{16}$″ 33.3 mm.	$1\frac{5}{16}$″ 33.3 mm.	Z830030	—
16	MT 16/1	8.2-12.4	0.995: 1	1 watt	8″ 203.2 mm.	$1\frac{7}{8}$″ 47.6 mm.	$1\frac{3}{4}$″ 44.4 mm.	Z830004	2lb. 12oz. 1.25 kgrm.
15	MT 15/1	7.0-10.0	0.995: 1	1 watt	10″ 254.0 mm.	$1\frac{7}{8}$″ 47.6 mm.	$1\frac{7}{8}$″ 47.6 mm.	Z830034	—
14	MT 14/1	5.5-8.2	0.995: 1	5 watt	12″ 304.8 mm.	$3\frac{1}{8}$″ 79.4 mm.	$3\frac{1}{8}$″ 79.4 mm.	Z830038	—
12	MT 12/1	3.95-5.85	0.995: 1	5 watt	17″ 431.8 mm.	$3\frac{5}{8}$″ 92.1 mm.	$3\frac{5}{8}$″ 92.1 mm.	Z830042	—

Finish : Grade I Instrument Finish.

Flanges : Alternative flanges can be fitted to order. For details, see flange data sheet.

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London Office : 49 Conduit Street, London, W.1. Telephone : Regent 3534. Telegrams and Cables : Santronic, London
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matched terminations

GRADE 2

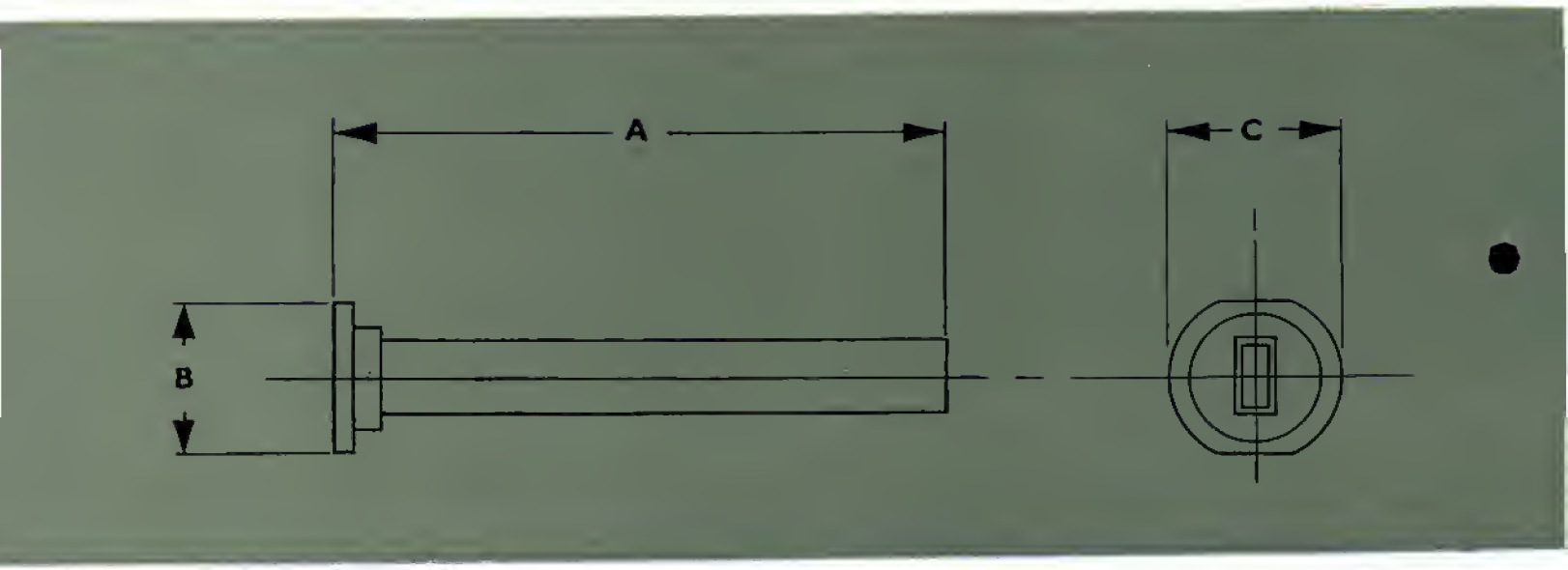
MT 16/2

One of the primary requirements in a microwave laboratory is a termination which has a negligibly small reflection coefficient. To this end considerable care has been taken in design and manufacture to ensure that adequate tolerances are achieved in all critical parameters. The dissipative material is made of an air-cured resin loaded with a finely divided iron powder, carefully mixed to ensure a uniform consistency. The shape given to the resin has been chosen so as to introduce it gradually to the travelling-wave in the guide. This produces a slowly increasing attenuation constant with a small initial discontinuity. The high absorptive power of the material allows the overall length of the termination to be kept very small.

Care has been taken to ensure that the aperture is rectangular and close to the nominal dimensions of the guide, and changes in guide cross-section take place only gradually along its length. The coupling is accurately flat and true with respect to the waveguide axis.

Choke-type couplings at present in use have reflection coefficients much greater than the terminations being described and are therefore not used.

specifications



Wave Guide Size	Type No.	Frequency Range in kMc/s	V.S.W.R.	Power Handline Capacity	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges*
WG 18	MT 18/2	12.4—18	0.99: 1	1 Watt mean	6″ 152.4 mm.	$1\frac{5}{16}$″ 33.3 mm.	$1\frac{5}{16}$″ 33.3 mm.	$3\frac{1}{4}$ oz. 92 grm.	Z830030
WG 16	MT 16/2	8.2—12.4	0.99: 1	5 Watt mean	7″ 177.8 mm.	$1\frac{7}{8}$″ 47.6 mm.	2″ 50.8 mm.	8 oz. 226.8 grm.	Z830003
WG 15	MT 15/2	7.0—10.0	0.99: 1	5 Watt mean	8″ 203.2 mm.	$1\frac{7}{8}$″ 47.6 mm.	$1\frac{7}{8}$″ 47.6 mm.	13 oz. 369 grm.	Z830034
WG 14	MT 14/2	5.0—7.8	0.99: 1	10 Watt mean	9″ 228.6 mm.	$3\frac{1}{8}$″ 79.37 mm.	$3\frac{1}{8}$″ 79.37 mm.	1 lb. 12 oz. 793.8 grm.	Z830038
WG 12	MT 12/2	3.95—5.85	0.99: 1	10 Watt mean	$12\frac{1}{2}$″ 317.5 mm.	$3\frac{5}{8}$″ 92 mm.	$3\frac{5}{8}$″ 92 mm.	2 lb. 12 oz. 1250 grm.	Z830042

*Flanges: Details of all flanges can be found on flange data sheet.
Alternative flanges can be supplied to order.
Finish: Grade I Instrument Finish.

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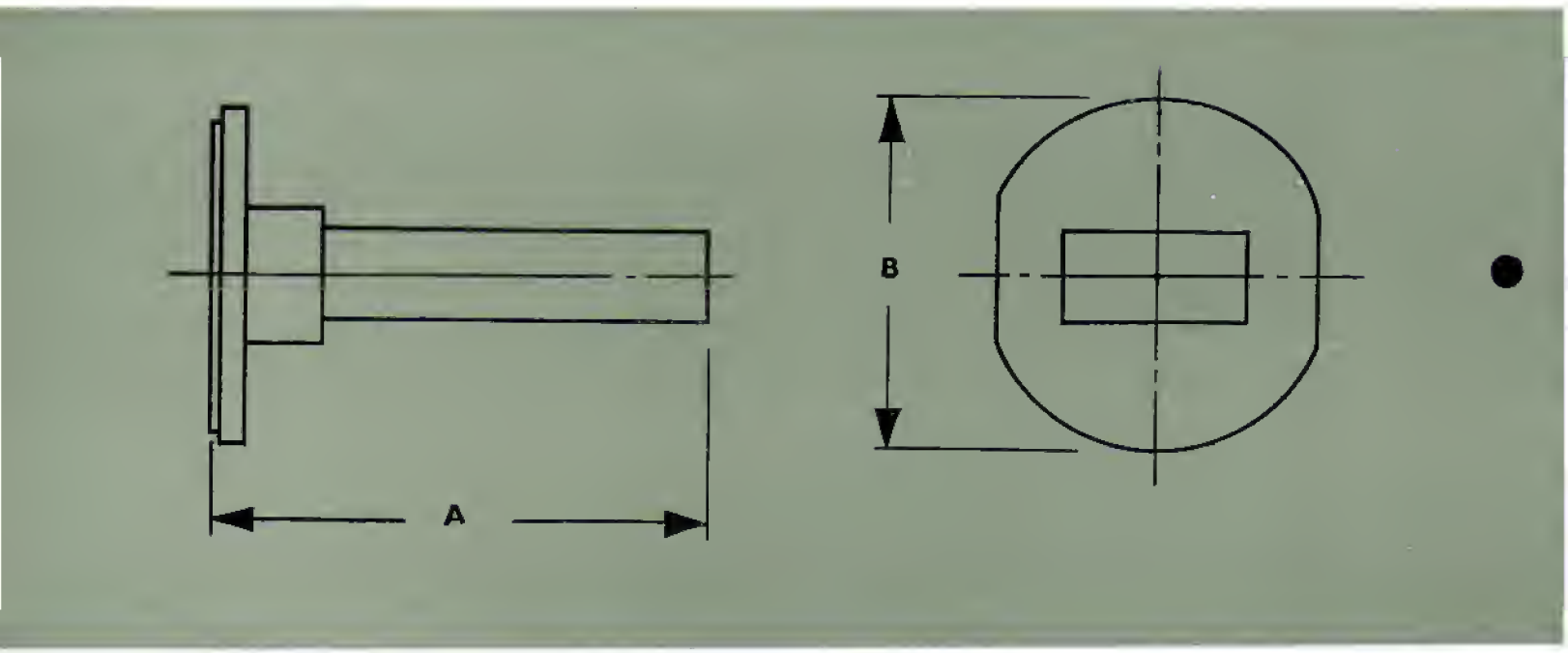
matched loads

ML 16

These compact matched terminations have many useful applications in the laboratory, where, extremely good V.S.W.R.'s are not required.

The dissipative wedge of iron loaded resin is fixed into a short section of the waveguide which is closed at the back. The power radiated from the termination will therefore be low.

specifications



Wave Guide Size	Type No.	V.S.W.R.	Frequency Range in kMc/s	Maximum Mean Power Dissipation	Dimensions A	Dimensions B	Weight	Flange*
WG 18	ML18	0.97:1	12.4-18.0	1 Watt	$2\frac{3}{4}$" 69.8 mm.	$1\frac{5}{16}$" 33.3 mm.	2 oz. 56.7 gms.	Z830030
WG 16	ML16	0.97:1	8.5-12.4	1 Watt	$2\frac{1}{2}$" 63.5 mm.	2" 50.8 mm.	5 oz. 141.7 gms.	Z830004
WG 15	ML15	0.97:1	6.5-10.0	1 Watt	$4\frac{1}{2}$" 102.5 mm.	$1\frac{7}{8}$" 48 mm.	8 oz. 226.8 grm.	Z830034
WG 14	ML14	0.97:1	5.0-7.8	5 Watt	$4\frac{1}{2}$" 102.5 mm.	$3\frac{1}{16}$" 78 mm.	15 oz. 425 grm.	Z830038
WG 12	ML12	0.97:1	3.95-5.85	5 Watt	$5\frac{5}{8}$" 143 mm.	$3\frac{5}{8}$" 92 mm.	28 oz. 795 grm.	Z830042

Finish : Grade 1 Instrument Finish

*Flanges : Details of all flanges fitted are shown on flange data sheet
Alternative flanges can be fitted to order

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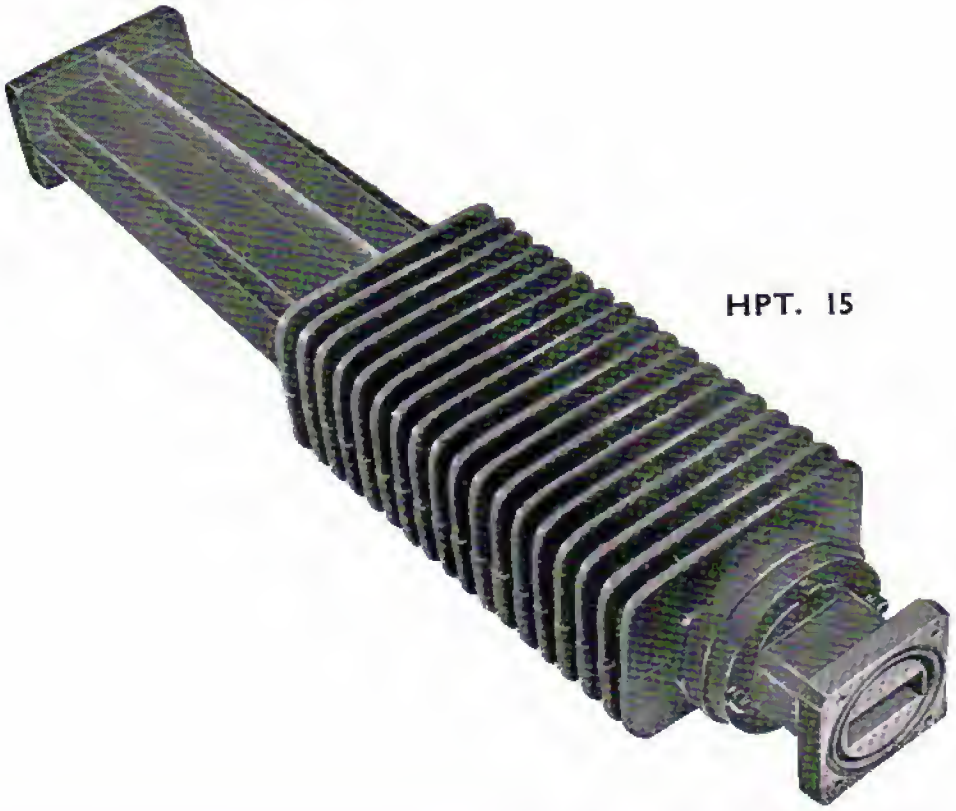
high power termination



HPT. 15

These broad band terminations are particularly useful in the laboratory or field when it is desired to make system alignment checks or low level measurements without actually radiating energy with aerials. Forced air cooling is not required, even for extremely high average powers, and the terminations may be operated at the full peak power rating of the associated rigid waveguide.
Each dummy load consists of a DTD.424 aluminium alloy casting containing high loss dielectric material consisting of high alumina cement loaded with micro-fine graphite. This material is shaped to absorb power uniformly and produce minimum V.S.W.R.

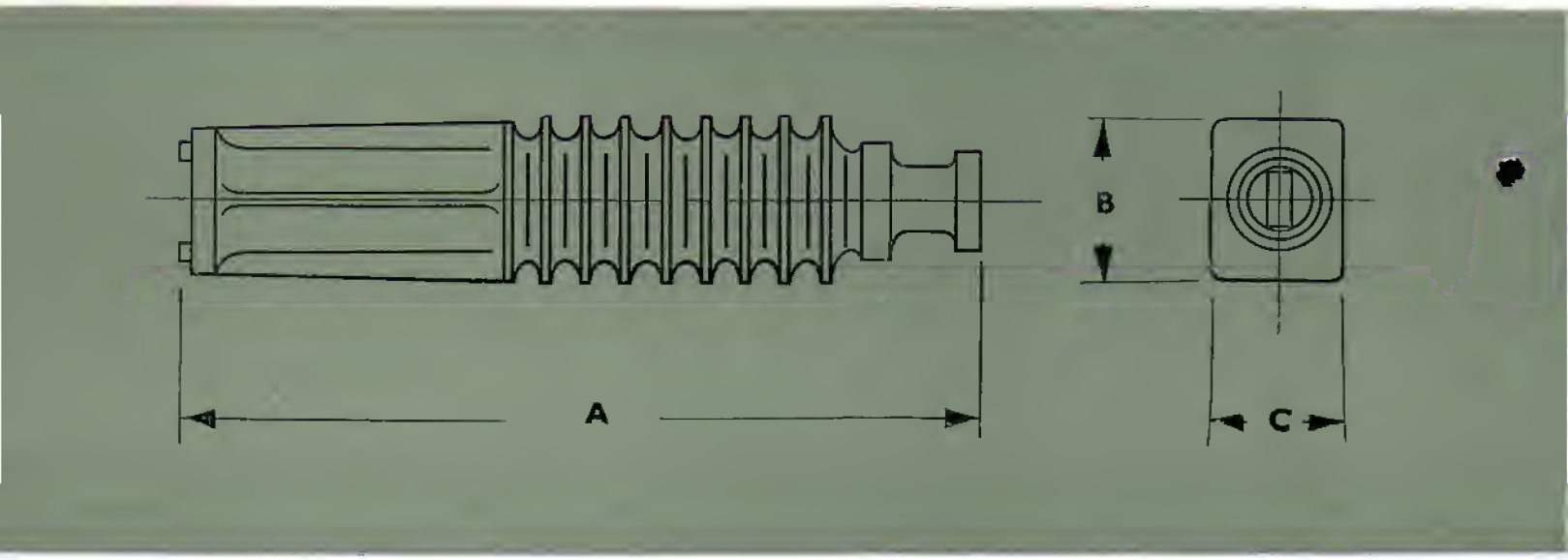
During manufacture metallic wedges are broached in the broad face of the waveguide, providing a smooth metallic surface in that section of the load where the highest electric field intensity exists.
This design eliminates both breakdowns due to surface roughness of the absorptive material and any destructive "hot spots" in the dissipative walls. It also provides uniform dissipation per unit length, in contrast to the constant attenuation per unit length typical of standard dissipative wall loads.

An additional factor contributing to the high power handling capacity of these loads is the use of binders that combine excellent mechanical strength with stability at extremely high temperatures.

A mica window ahead of the dissipative structure prevents moisture absorption or emission by the load due to repeated temperature cycling. Any possibility of trouble in the field due to water vapour contamination in this portion of the waveguide run is thereby eliminated.

Energy leakage from this device is negligible.

The waveguide 15 high power termination is Ministry of Supply approved, type 4735 Stores Ref. No. 10S/16665.



SPECIFICATIONS

Wave Guide Size	Type No.	Frequency range in kMc/s	V.S.W.R.	Peak Power in kW.	Mean power handling in W.	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges*
WG 16	HPT 16	8.2—12.0	0.9: 1	300	300	16¼" 412.7 mm.	3½" 88.9 mm.	2½" 63.5 mm.	4 lb. 11 oz. 2.13 kg.	Z830003 or Z830004
WG 15	HPT 15	7.5—10.0	0.9: 1	300	300	16¼" 412.7 mm.	3½" 88.9 mm.	2½" 63.5 mm.	4 lb. 11 oz. 2.13 kg.	Z830033

Finish: Anodised, followed by zinc chromate primer and finished in matt black, stove enamel to Spec. DTD 235.

Flanges: Alternative British or American flanges fitted to order.
*Details of flanges on flange data sheet.

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dissipative wedges

ALL WAVEGUIDE SIZES

The dissipative material is a dispersion of iron powder (average particle size 5 micron) in a resinous compound.

This mixture is prepared under laboratory conditions and evacuated to remove all air. The mix is then poured into appropriate moulds to polymerise.

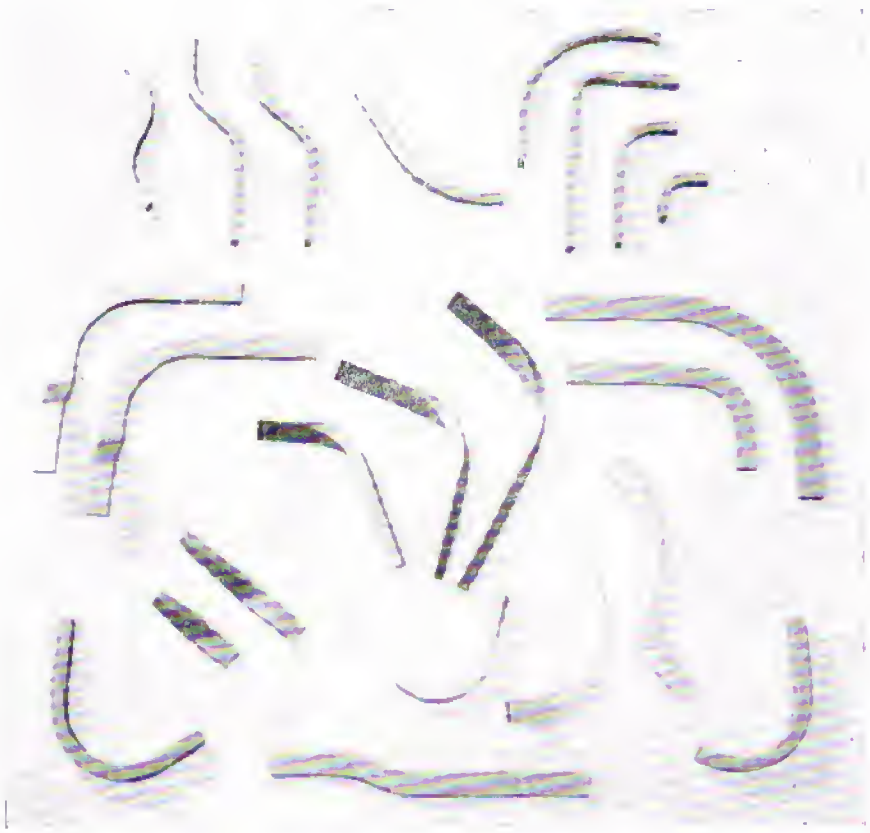
The resultant casting has excellent dimensional stability, weather resistance and electrical properties.

In X band the 6⅛" taper can be expected to give V.S.W.R. of better than 0.995:1. The short load will give a V.S.W.R. of 0.95:1.

Insertion of the long taper into an accurately sized section of waveguide will produce a termination meeting Grade 1 requirements.

Wedges designed to customers' specifications—prices on application.

waveguide bends and twists



We are equipped to supply Waveguide Bends and Twists in aluminium, copper, or brass, in all standard waveguide sizes with radii and angle of bend to customers' requirements.

Quotations can be given for complete aircraft radar installations and miscellaneous waveguide runs, and your enquiries are invited.

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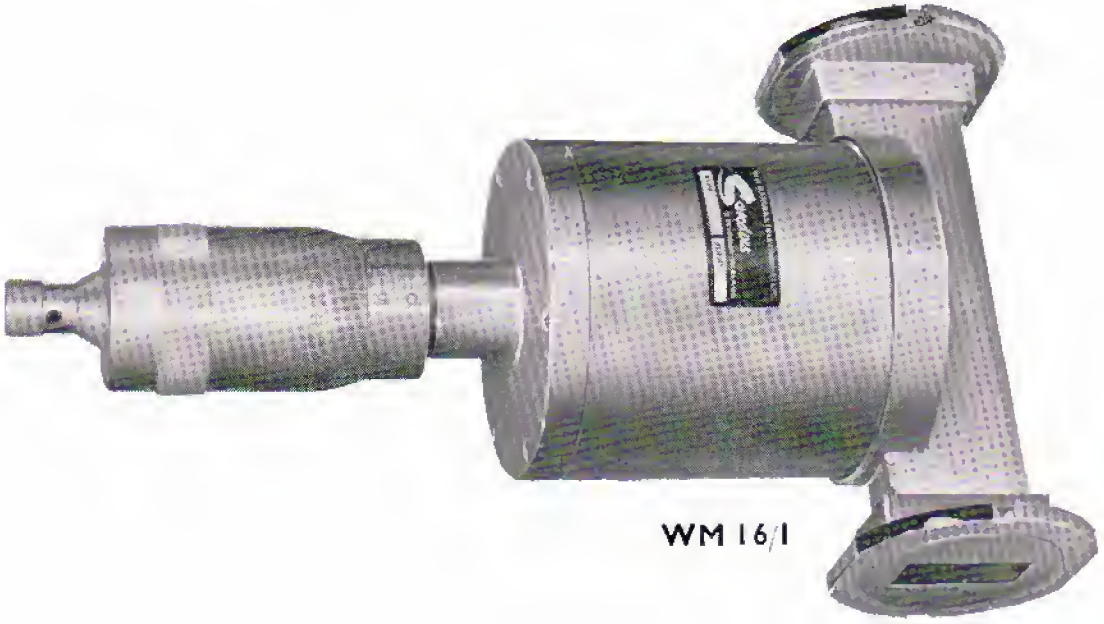
wave meters

GRADE 1



WM 16/1

These instruments are wide band absorption type wave meters covering the frequency range of the waveguide size in two modes. By this method the Q is kept above 5,000 so providing a measurement of frequency of sufficient accuracy for normal test bench measurements.

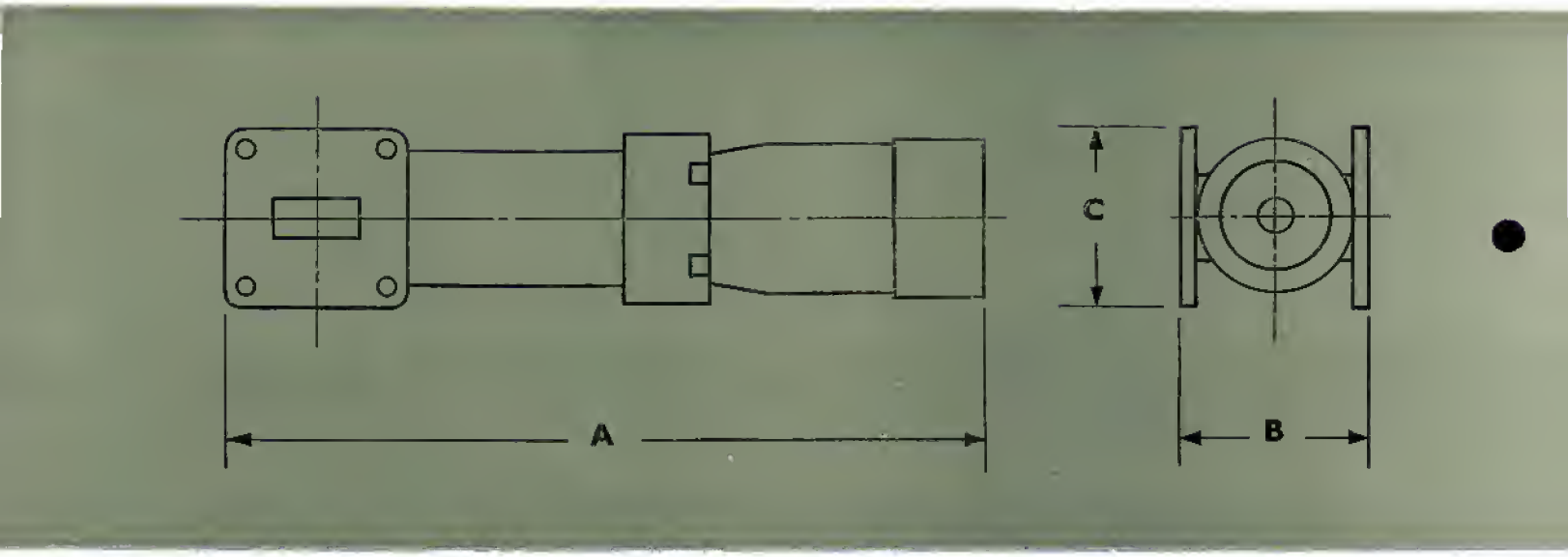
The position of resonance is indicated by a decrease in signal strength of approx. 30% at any detector following it. This allows rapid frequency measurements to be made without the need for multiplicity of detecting systems.

Coupling to the waveguide is made by holes incorporating filters to attenuate unwanted modes. This completely eliminates spurious responses thoughout the quoted range.

The piston is of a non-contacting type with a high impedance section incorporated, and is coupled directly to the micrometer which provides negligible backlash and no coupling to the back cavity.

The instruments are calibrated, and a graph supplied with each instrument; this allows accurate interpolation at intermediate frequencies.

specifications



Wave Guide Size	Type No.	Frequency Coverage kMc/s	Mode Used	Loaded Q	Reset Accuracy	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges
WG 18	WM 18/1	11.5-18.0 14.8-18.0	TE 111 TE 112	Above 5000	0.2 Mc/s	$5\frac{7}{16}$" 138.1 mm.	$1\frac{1}{4}$" 31.7 mm.	$1\frac{5}{16}$" 33.3 mm.	1lb. 454 grms.	Z830030 both ends
WG 16	WM 16/1	8.2-12.4 10.0-12.4	TE 011 TE 012	Above 5000	0.2 Mc/s	8" 203 mm.	4" 101.6 mm.	$2\frac{1}{2}$" 63.5 mm.	$2\frac{1}{2}$lbs. 1.13 kg.	Z830004 both ends

Flanges : Details of all flanges are shown on flange data sheet.
Alternative British or American flanges fitted to order.

Finish : Grade I Instrument Finish.

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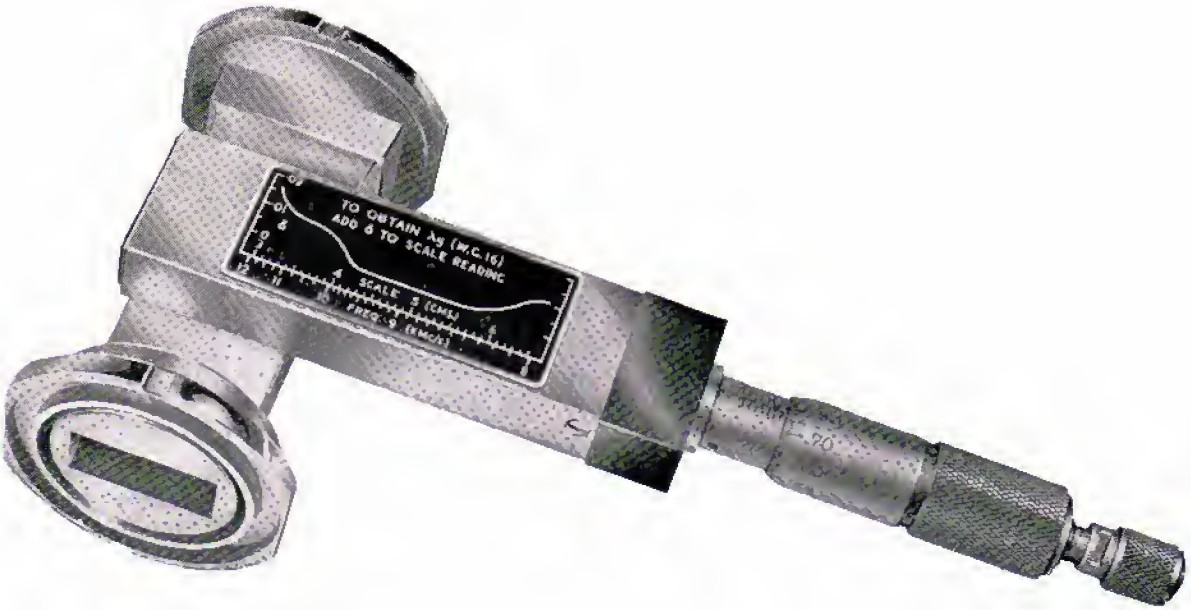
GRADE II

wave meters

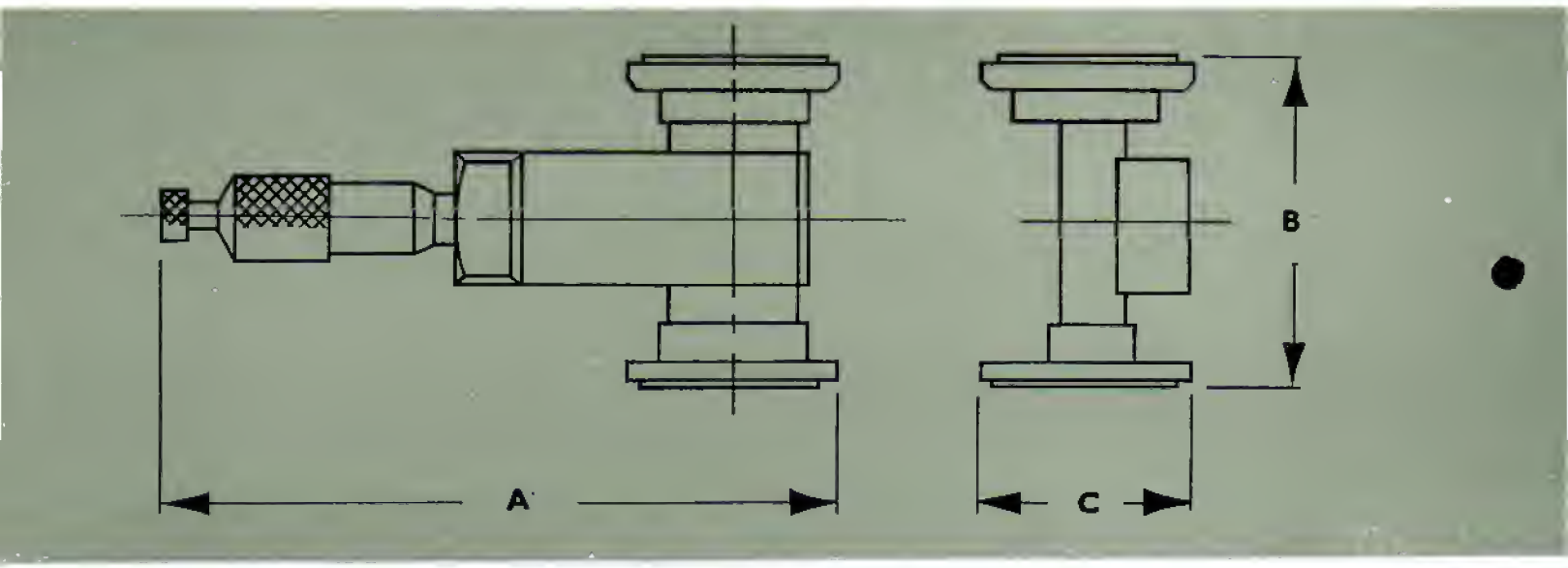


WM 16/2

These absorption wavemeters use a TE011 resonator of rectangular section having a cut off wavelength equal to that for each standard waveguide size. The use of this rectangular section resonator ensures complete freedom from interfering or crossing resonator modes over the whole frequency range normally specified for the waveguide size. Thus the wavemeter is free from ambiguity, apart from a transverse resonance occuring at a setting outside the operating range. The tuning plunger design is the same as that in the short circuit terminations in which the reflecting plane coincides closely with the front face of the plunger over the whole of the waveguide frequency band. The plunger position is controlled by a micrometer and the linkage is kinematically designed to eliminate backlash.

The coupling to the wavemeter is by means of a cruciform directional coupler which is well matched and which maintains a very consistent coupling over the whole band. The use of a directional coupler ensures that the coupling discontinuity within the resonator is reduced to a minimum and therefore the physical length of the cavity coincides closely with its electrical length. Because of this it is possible to use a micrometer with a specially engraved barrel which reads the wavelength in the waveguide size direct. This facility is of considerable use to designers, as the guide wavelength is usually the design parameter rather than the frequency or free space wavelength.

grade II wavemeters



SPECIFICATIONS

Wave Guide Size	Type No.	Frequency Coverage in kMc/s	Loaded Q	Mechanical Discrimination	Electrical Resolution	Dimensions A	Dimensions B	Dimensions C	Weight	Flanges Normally Fitted*
WG 18		SEE	GRADE	I WAVEMETER	SHEET					
WG 16	WM16/2	8.2–12.0	1000	2 Mc/s at 12000 Mc/s 1 Mc/s at 8200 Mc/s	Better than 2 Mc/s	$6\frac{1}{2}$″ 165.1 mm.	3″ 76.2 mm.	2″ 50.8 mm.	13 oz. 368.5 gms.	Z830003 one end Z830004 the other
WG 15	WM15/2	7.0–10.0	1000	1.5 Mc/s at 10,000 Mc/s 1.0 Mc/s at 7,000 Mc/s	Better than 1.5 Mc/s	8″ 203.2 mm.	$3\frac{3}{4}$″ 95.25 mm.	$1\frac{7}{8}$″ 47.6 mm.		Z830034 one end Z830033 the other
WG 14	WM14/2	5.8–8.2	1000	1.0 Mc/s at 8.2 kMc/s 0.75 Mc/s at 5.8 kMc/s	Better than 1.0 Mc/s	$9\frac{1}{4}$″ (approx)	$4\frac{7}{16}$″ (approx)	$3\frac{3}{16}$″ (approx)		Z830038
WG 12	WM12/2	3.95–5.85	1000	0.75 Mc/s at 5.85 kMc/s 0.5 Mc/s at 3.95 kMc/s	Better than 0.75 Mc/s	12″ (approx)	6″ (approx)	$3\frac{13}{16}$″ (approx)		Z830042

*Details of all flanges fitted are shown on flange data sheet
Alternative British or American flanges fitted to order
Finish : Grade I Instrument Finish

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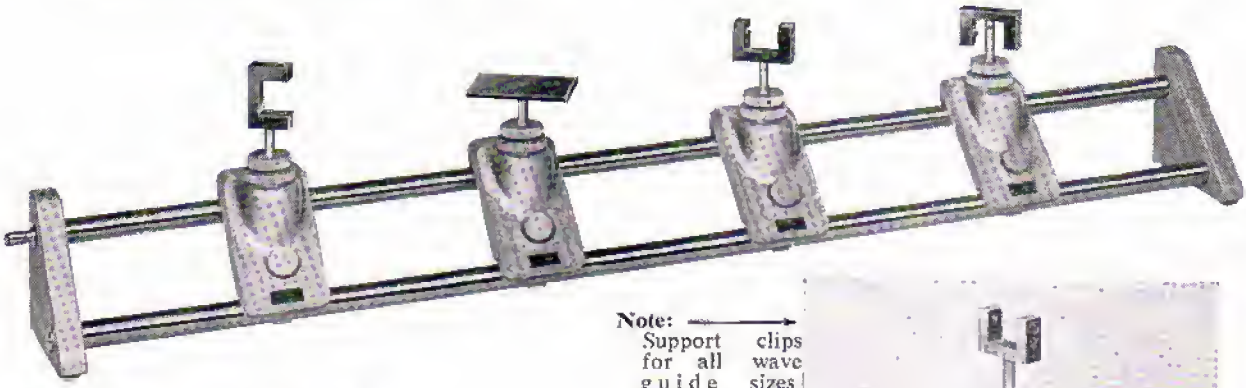
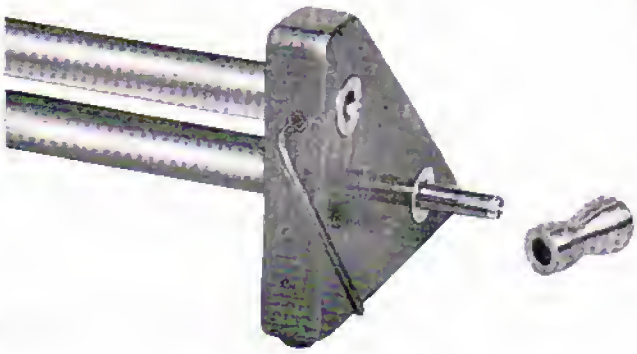
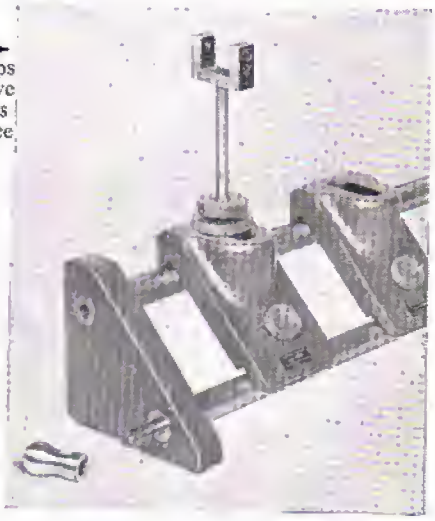
waveguide support bench



Note: Support clips for all wave guide sizes available. See price list.





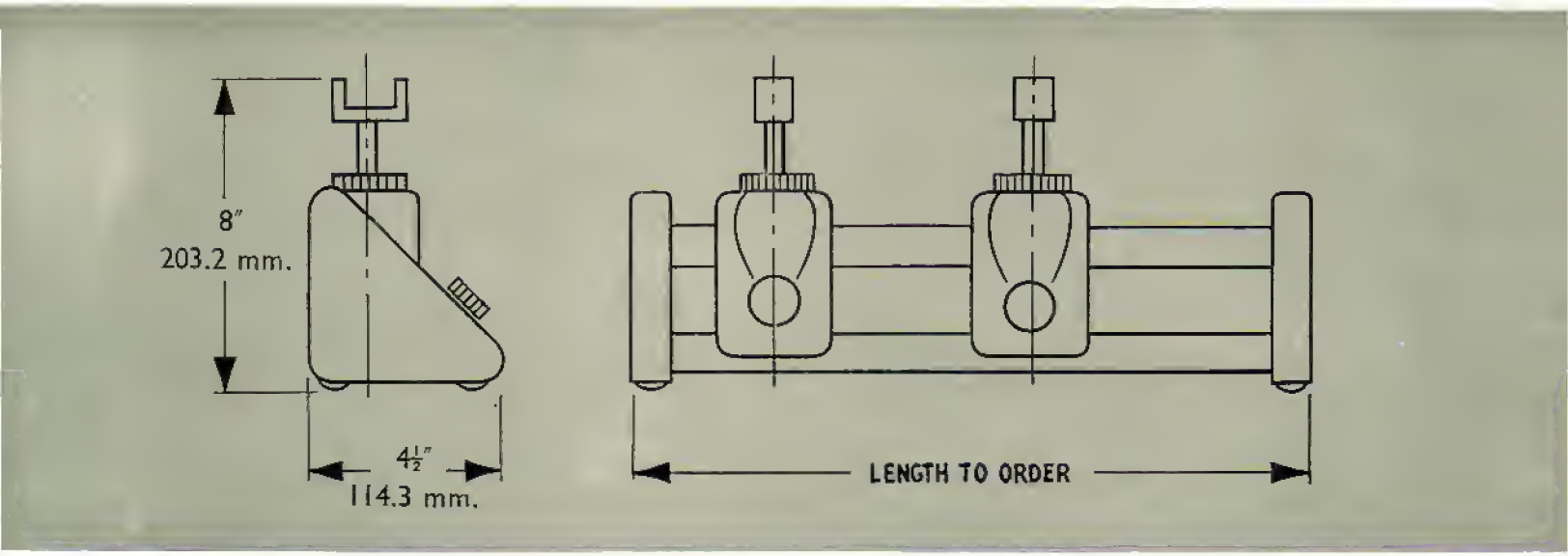
This waveguide bench is designed to ensure that the layout of the supported equipment is not restricted in any way. Projections, changes of level and of size are all easily accommodated.

The base consists of two rails held by end plates. The rails are normally locked in the end plates by Allen screws. By slackening these, the end plates may be rotated so that the bench can be set up on an uneven surface. In addition, sprung pins can be provided for joining lengths of bench quickly and positively.

The carriages are designed for movement along the bench only and may be quickly locked in any position. The clamp assembly may be moved in the horizonal plane, at right angles to the length of the bench in slots in the carriages, and also in the vertical plane. Thus movement of the clamp assembly is independently obtainable in three planes and there can also be rotation about the vertical axis.

specifications

The scope of adjustment is sufficiently large to allow for the semi-optical measurements of microwave lens system.
The carriages are very strong for their size and will carry heavy loads on the biggest span.
The normal support provided is of a U-type and may be used in either a horizontal or vertical position as shown. The waveguide is held positively by two ball catches. The supports can be provided in all sizes of standard waveguide from No. 10 to No. 26 and special sizes if required. Other types of support available are tables which can be mounted normally or offset, and a special table for support of the standing wave meter.



The bench can be supplied in 1, 2 or 3 feet lengths with any number of carriages, as requested.

Finish

The end plates and carriages have a hammered finish in grey stove enamel.

Support Rails: Stainless steel.

Weights:

Bench: 1′: 4 lb. 10 oz. (2.1 Kgs.)
2′: 7 lb. 10 oz. (3.5 Kgs.)
3′: 10 lb. 10 oz. (4.8 Kgs.)

Carriages: 1 lb. 6 oz. (625 grammes).

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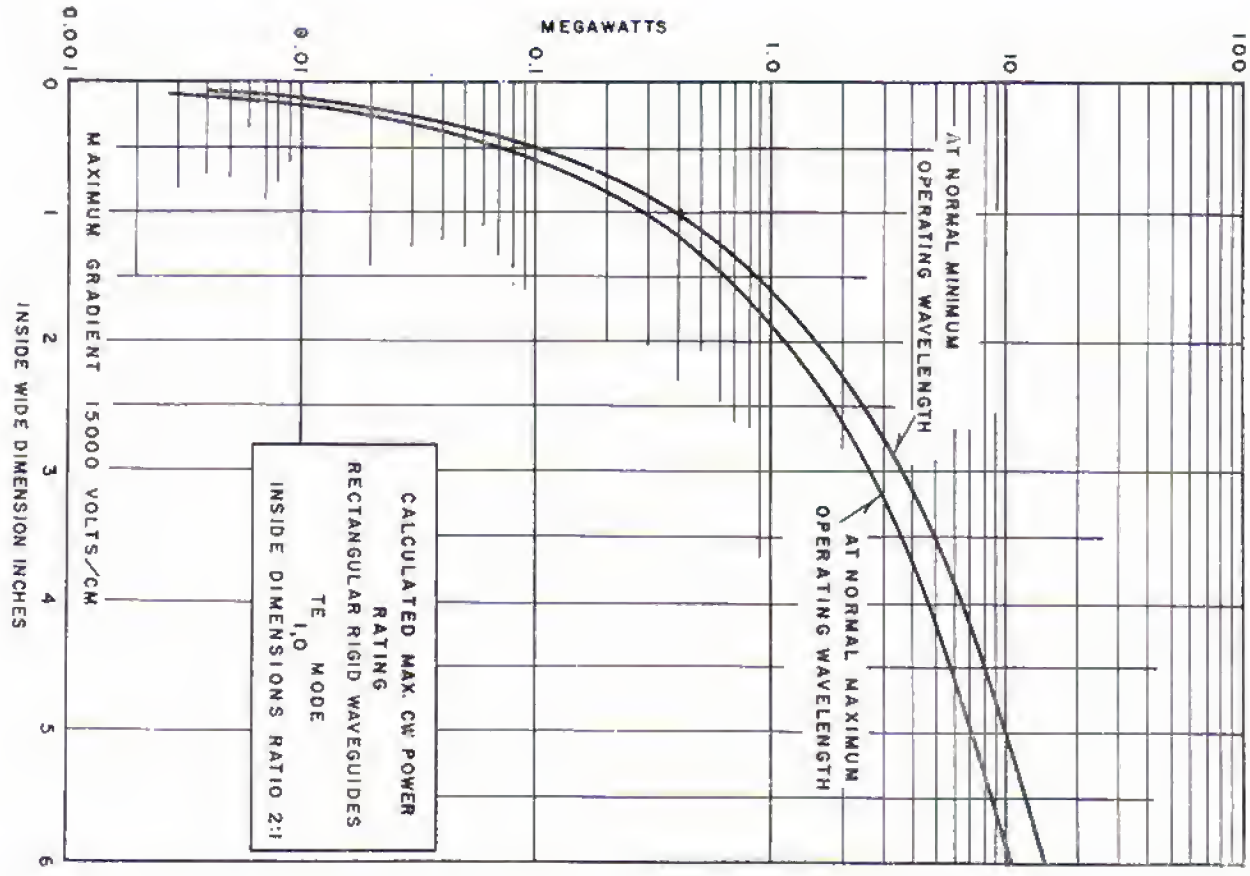
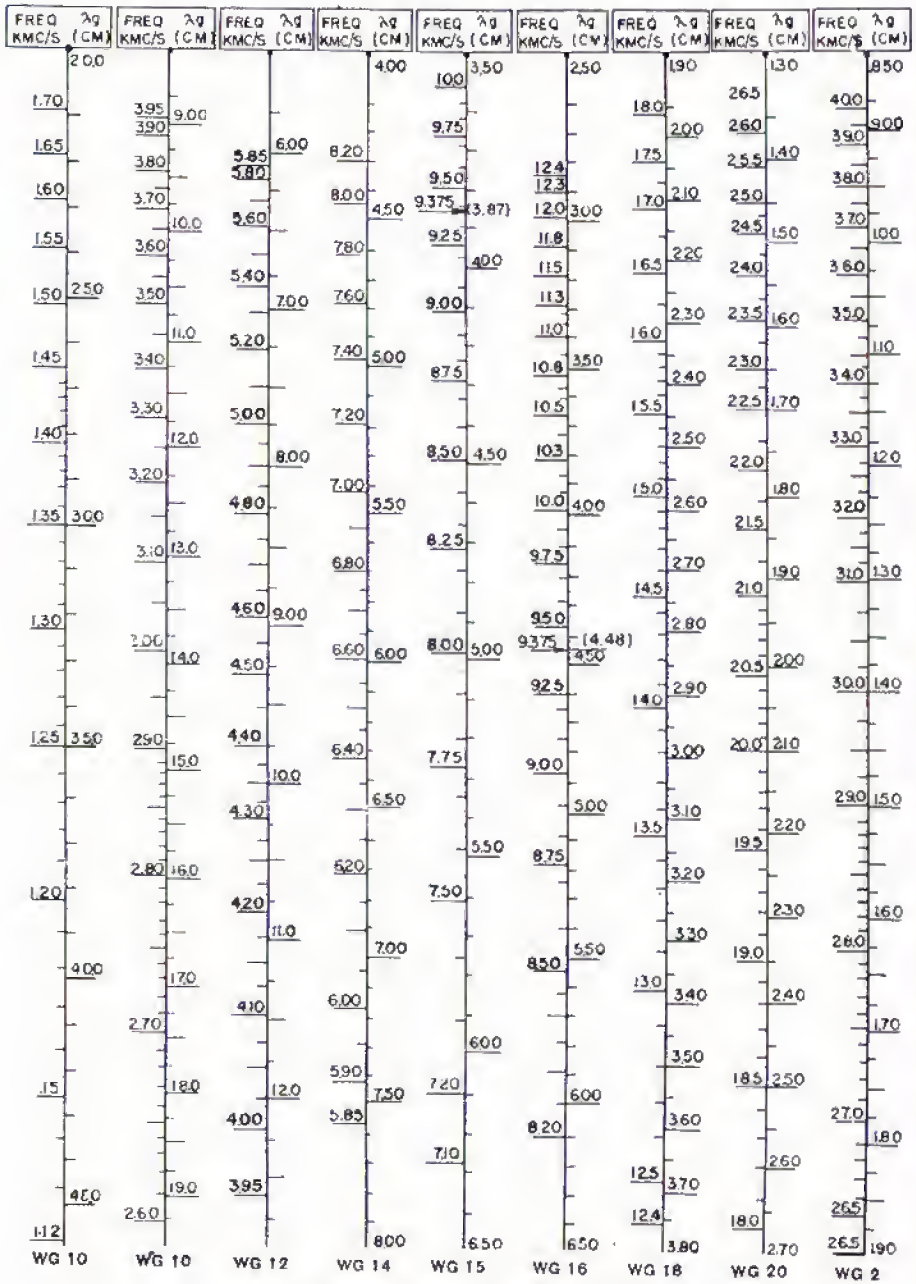
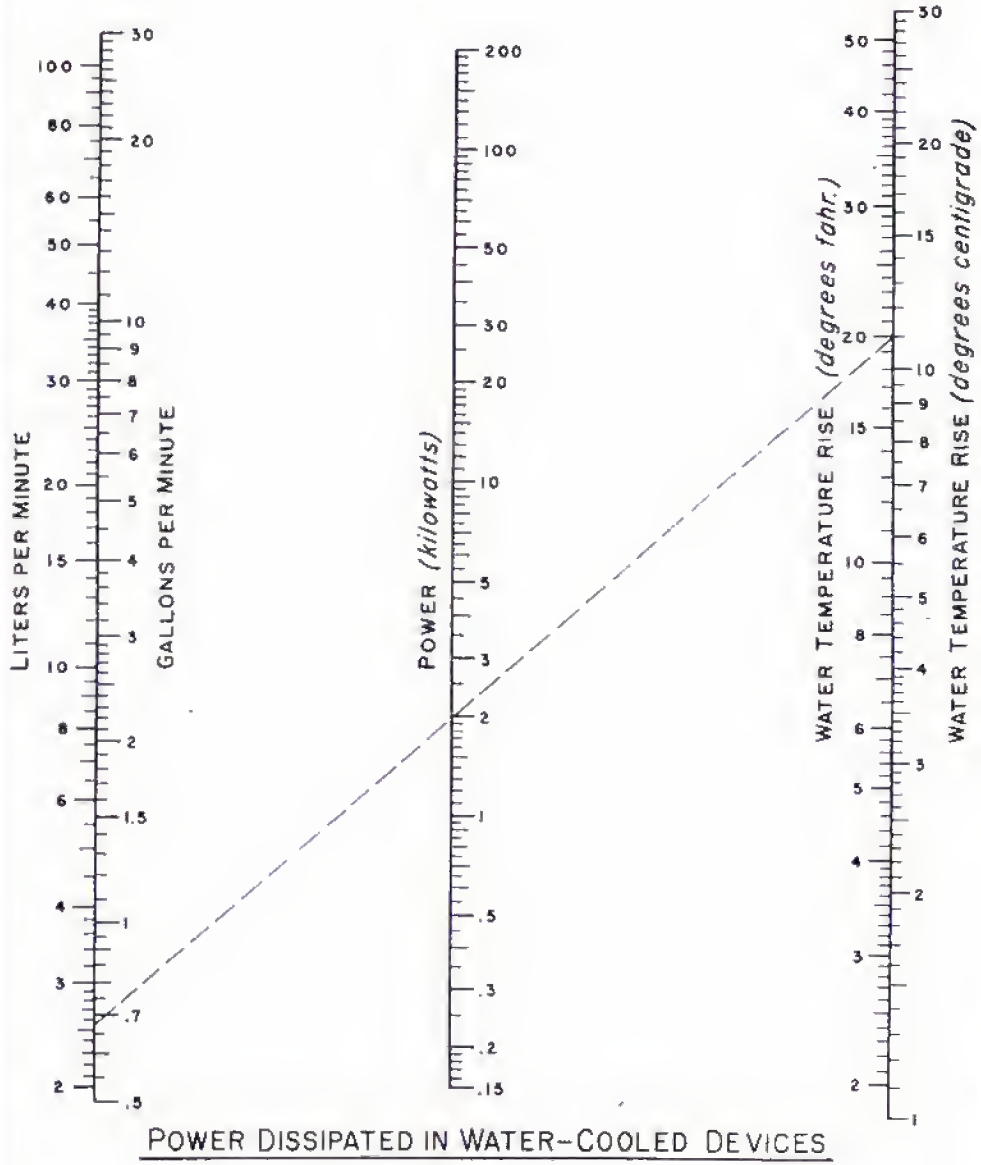


DIMENSIONS, TOLERANCES AND FREQUENCY RANGE FOR RIGID RECTANGULAR WAVEGUIDES

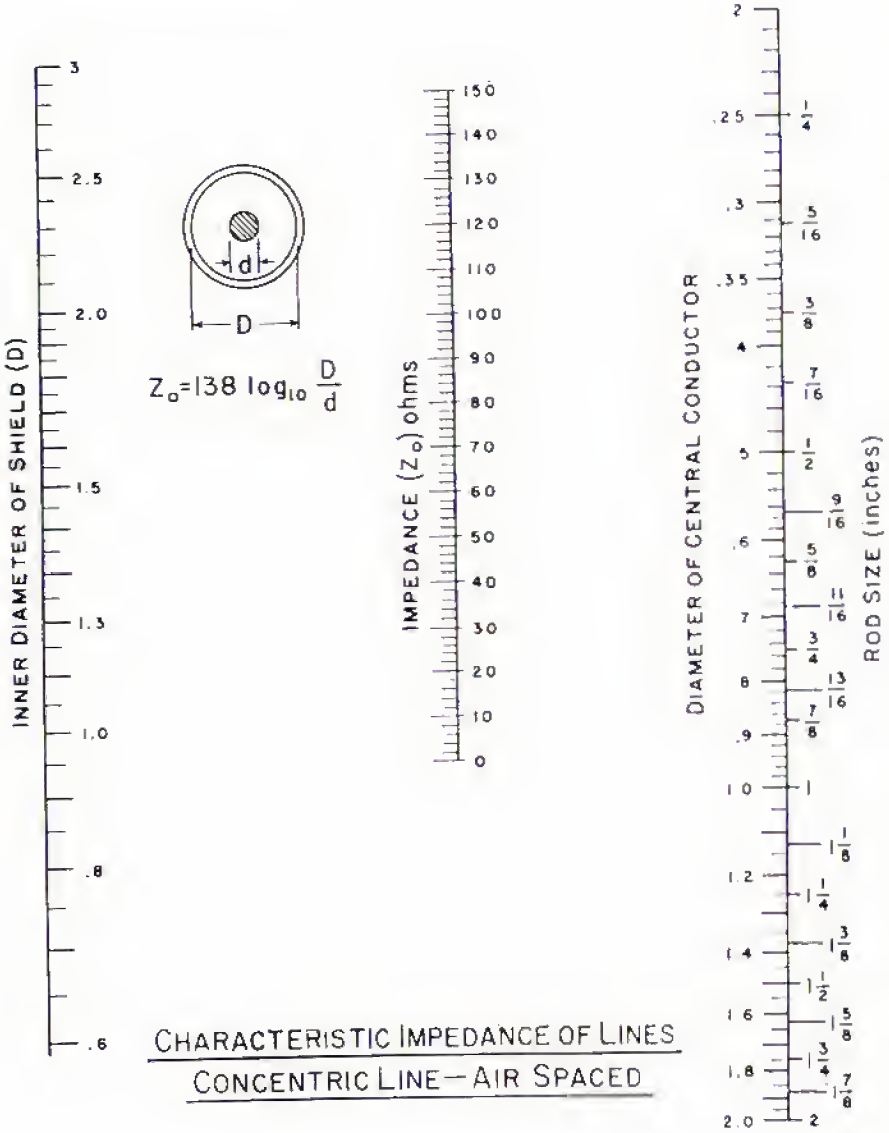
RCSC No. WG	RETMA DESIGNATION	FREQUENCY RANGE (KMC/S) FOR DOMINANT (TE_{10}) MODE	DIMENSIONS IN INCHES								MAXIMUM INNER RADIUS
			INNER DIMENSIONS			OUTER DIMENSIONS			WALL THICKNESS		
			BROAD WALL	NARROW WALL	TOLERANCE	BROAD WALL	NARROW WALL	TOLERANCE	NOMINAL	DEVIATION FROM MEAN	
2	WR1500	0.47.0.75	15.000	7.500	±.015	15.250	7.750	±.015	0.125	±.015	3/64
3	WR1150	0.64.0.96	11.500	5.750	±.015	11.750	6.000	±.015	0.125	±.015	3/64
4	WR975	0.75.1.12	9.750	4.875	±.010	10.000	5.125	±.010	0.125	±.010	3/64
5	WR770	0.96.1.45	7.700	3.850	±.005	7.950	4.100	±.005	0.125	±.009	3/64
6	WR650	1.12.1.70	6.500	3.250	±.005	6.660	3.410	±.005	0.080	±.008	3/64
7	WR510	1.45.2.20	5.100	2.550	±.005	5.260	2.710	±.005	0.080	±.008	3/64
8	WR430	1.70.2.60	4.300	2.150	±.005	4.460	2.310	±.005	0.080	±.008	3/64
9a	WR340	2.20.3.30	3.400	1.700	±.005	3.550	1.860	±.005	0.080	±.007	3/64
10	WR284	2.60.3.95	2.840	1.340	±.005	3.000	1.500	±.005	0.080	±.006	3/64
11a	WR229	3.30.4.90	2.290	1.145	±.005	2.418	1.273	±.005	0.064	±.005	3/64
12	WR187	3.95.5.85	1.872	0.872	±.005	2.000	1.000	±.005	0.064	±.004	1/32
13	WR159	4.90.7.05	1.590	0.795	±.004	1.718	0.923	±.004	0.064	±.004	1/32
14	WR137	5.85.8.20	1.372	0.622	±.004	1.500	0.750	±.004	0.064	±.004	1/32
15	WR112	7.05.10.00	1.122	0.497	±.004	1.250	0.625	±.004	0.064	±.004	1/32
16	WR90	8.20.12.40	0.900	0.400	±.003	1.000	0.500	±.003	0.050	±.004	1/32
17	WR75	10.00.15.00	0.750	0.375	±.003	0.850	0.475	±.003	0.050	±.004	1/32
18	WR62	12.4.18.00	0.622	0.311	±.003	0.702	0.391	±.003	0.040	±.003	1/64
19	WR51	15.00.22.00	0.510	0.255	±.0025	0.590	0.335	±.003	0.040	±.003	1/64
20	WR42	18.00.26.50	0.420	0.170	±.0020	0.500	0.250	±.003	0.040	±.003	1/64
21	WR34	22.00.33.00	0.340	0.170	±.0020	0.420	0.250	±.003	0.040	±.003	1/64
22	WR28	26.50.40.00	0.280	0.140	±.0015	0.360	0.220	±.002	0.040	±.002	1/64
23	WR22	33.00.50.00	0.224	0.112	±.0010	0.304	0.192	±.002	0.040	±.002	0.010
24	WR19	40.00.60.00	0.188	0.094	±.0010	0.268	0.174	±.002	0.040	±.002	0.010
25	WR15	50.00.75.00	0.148	0.074	±.0010	0.228	0.154	±.002	0.040	±.002	0.008
26	WR12	60.00.90.00	0.122	0.061	±.0005	0.202	0.141	±.002	0.040	±.002	0.006
27	WR10	75.00.110.00	0.100	0.050	±.0005	0.180	0.130	±.002	0.040	±.002	0.006



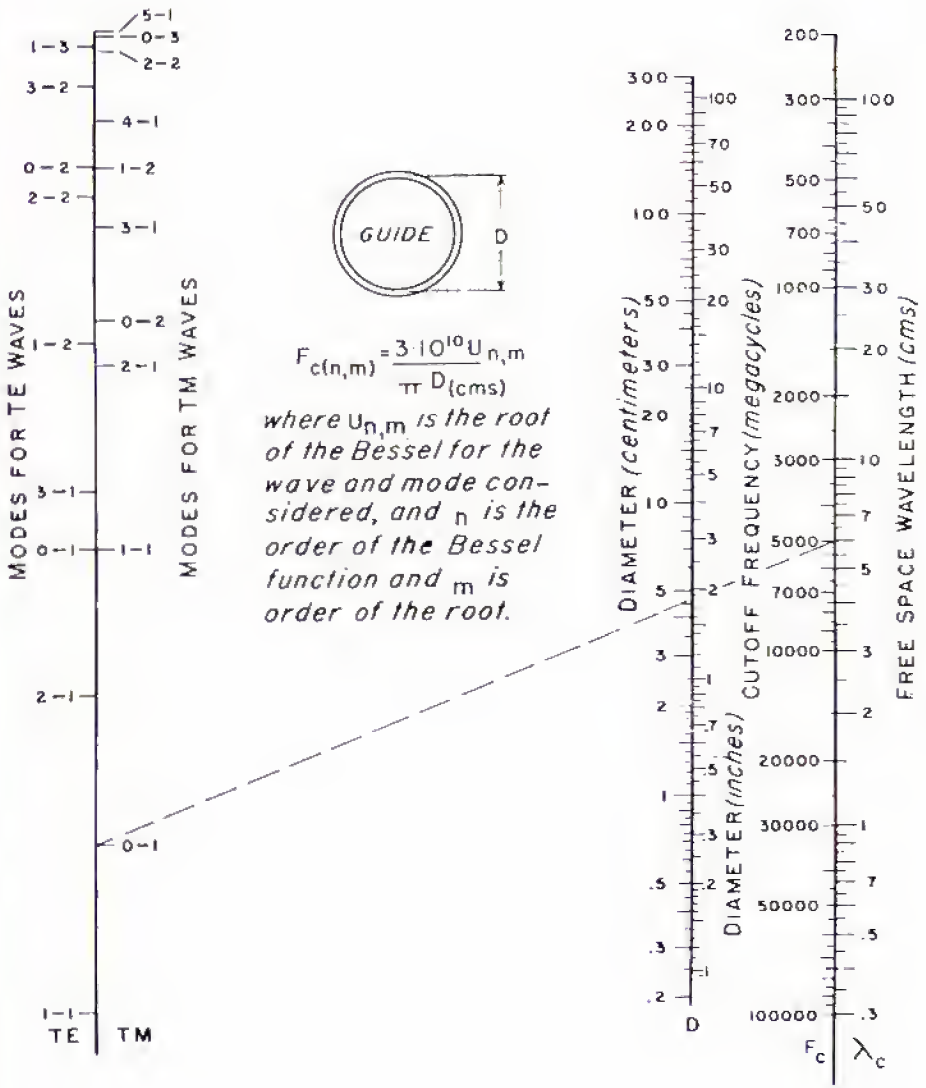
GUIDE WAVELENGTH VS FREQUENCY



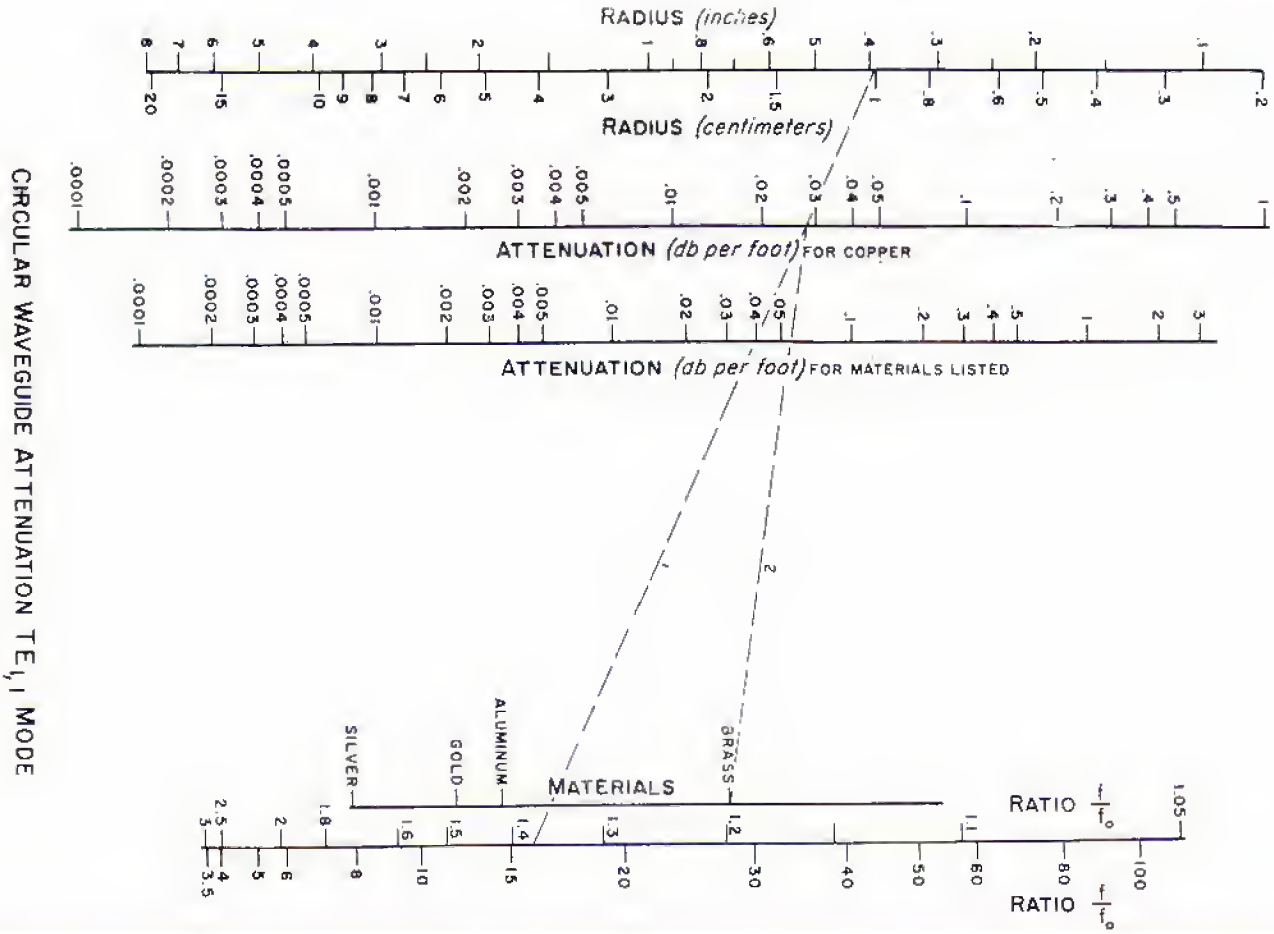
POWER DISSIPATED IN WATER-COOLED DEVICES

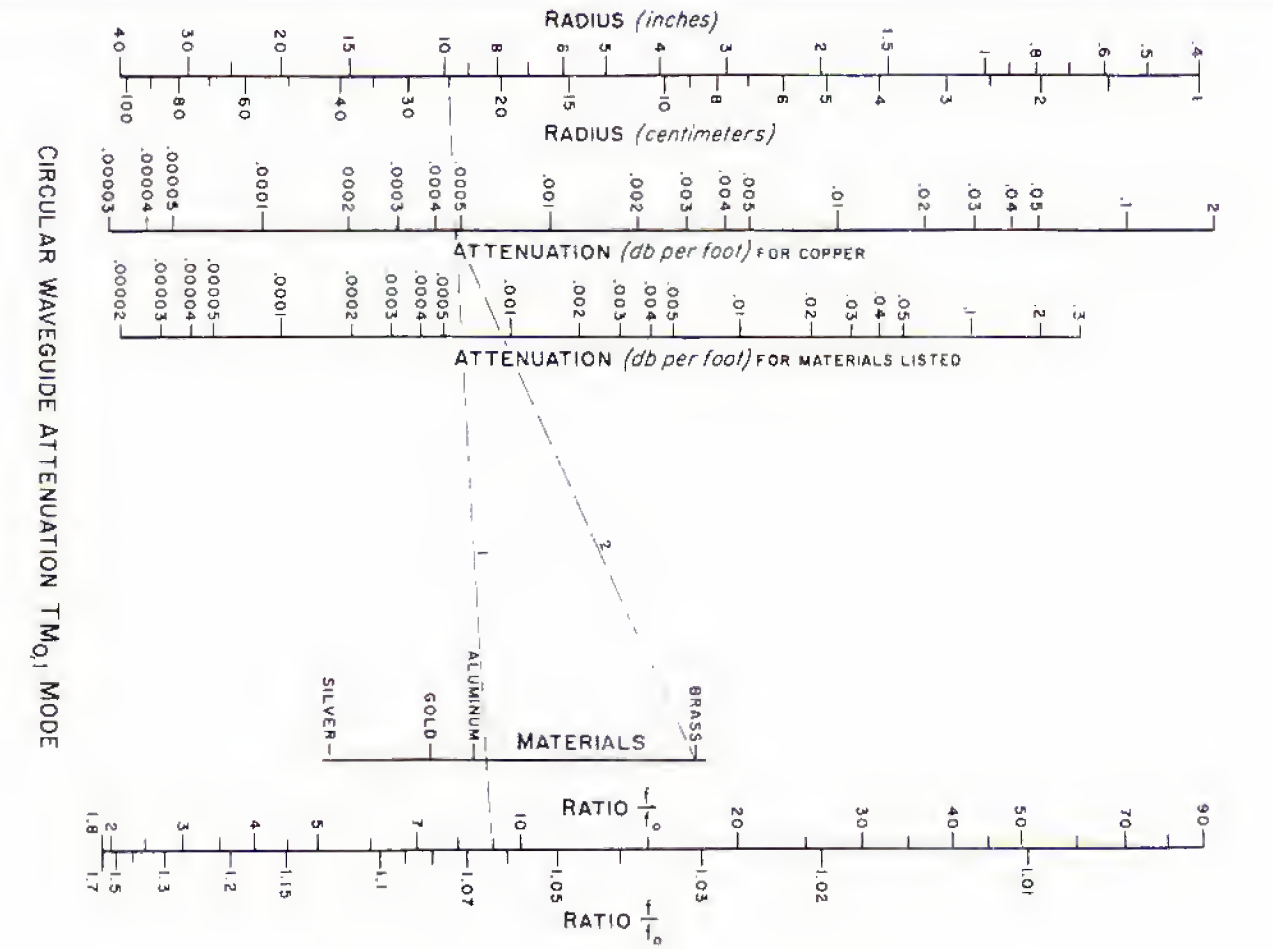


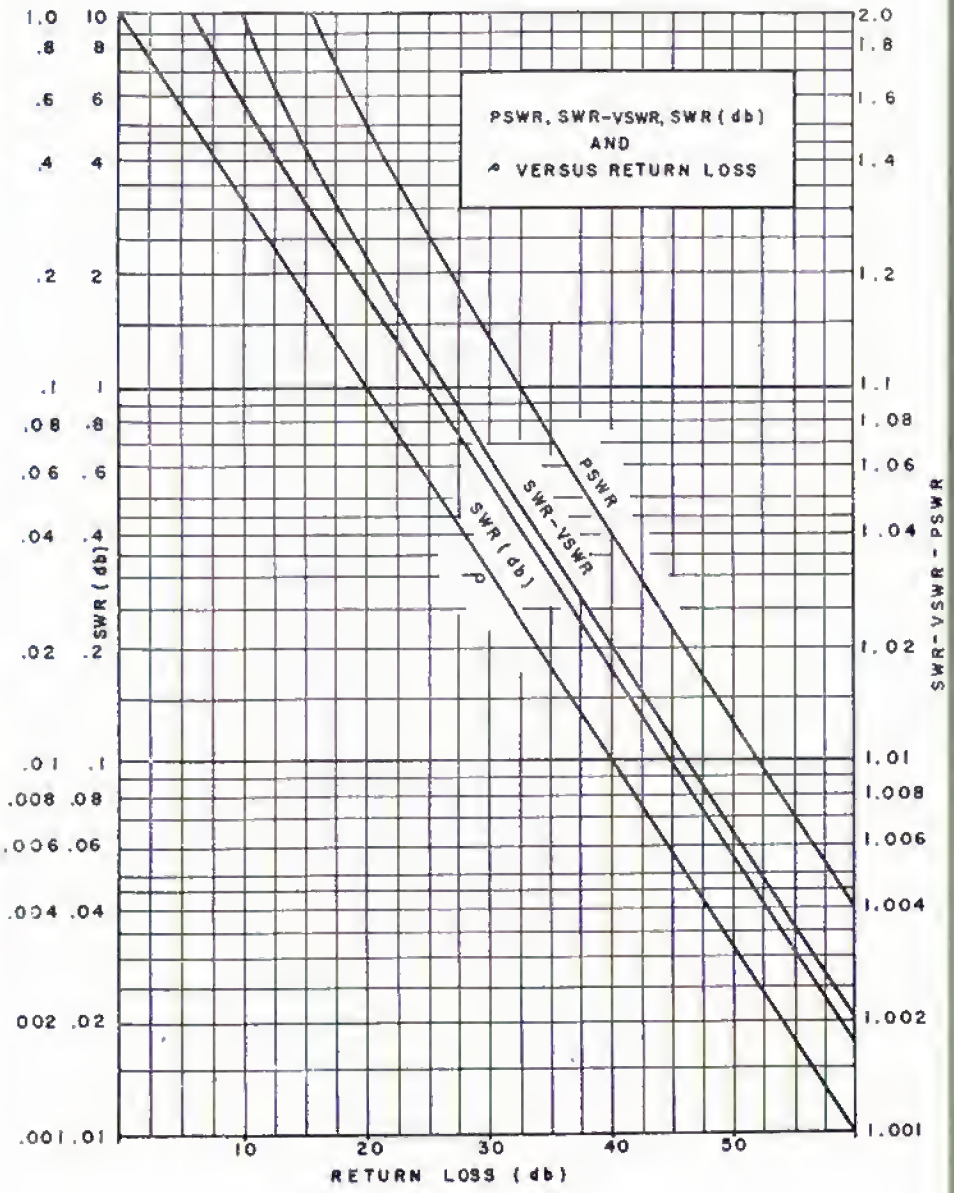
CHARACTERISTIC IMPEDANCE OF LINES
CONCENTRIC LINE—AIR SPACED

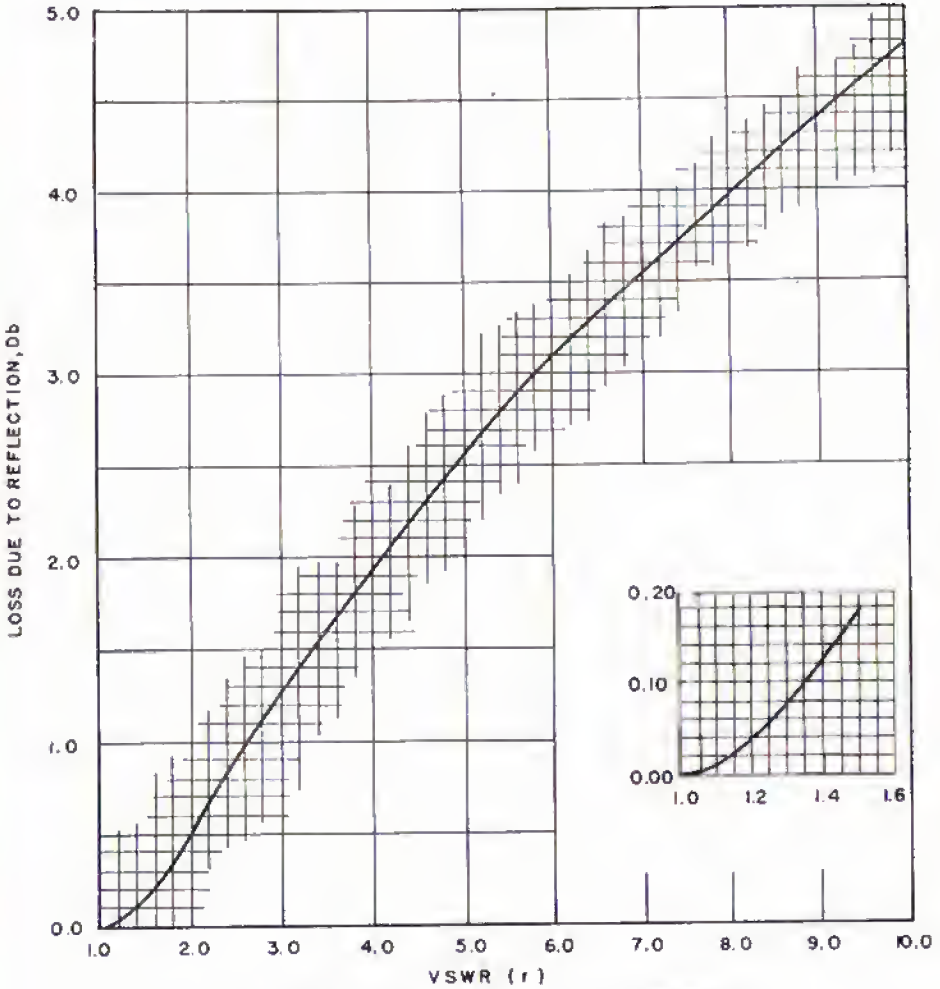


CIRCULAR WAVEGUIDE CUTOFF FREQUENCIES


CIRCULAR WAVEGUIDE ATTENUATION $TE_{1,1}$ MODE
RADIUS (inches)
RADIUS (centimeters)
ATTENUATION (db per foot) FOR COPPER
ATTENUATION (db per foot) FOR MATERIALS LISTED
SILVER
GOLD
ALUMINUM
BRASS
MATERIALS
RATIO $\frac{f}{f_c}$
RATIO $\frac{f}{f_c}$


CIRCULAR WAVEGUIDE ATTENUATION $TM_{0,1}$ MODE
RADIUS (inches)
RADIUS (centimeters)
ATTENUATION (db per foot) FOR COPPER
ATTENUATION (db per foot) FOR MATERIALS LISTED
SILVER
GOLD
ALUMINUM
BRASS
MATERIALS
RATIO $\frac{f}{f_c}$
RATIO $\frac{f}{f_c}$





POWER LOSS DUE TO REFLECTION

DERIVATION

$$Db = 10 \log_{10}\left(\frac{1}{1-(r)^2}\right)$$

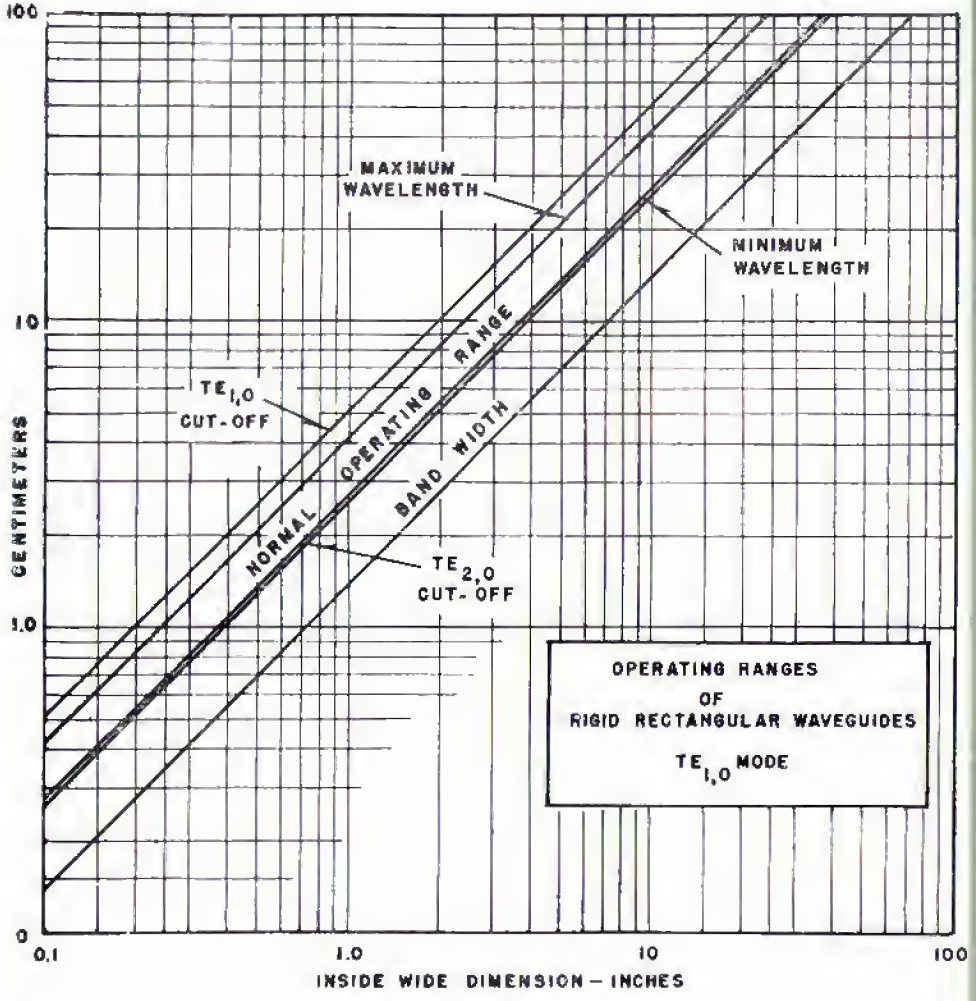
$$Db = 10 \log_{10}\frac{(r+1)^2}{4r}$$

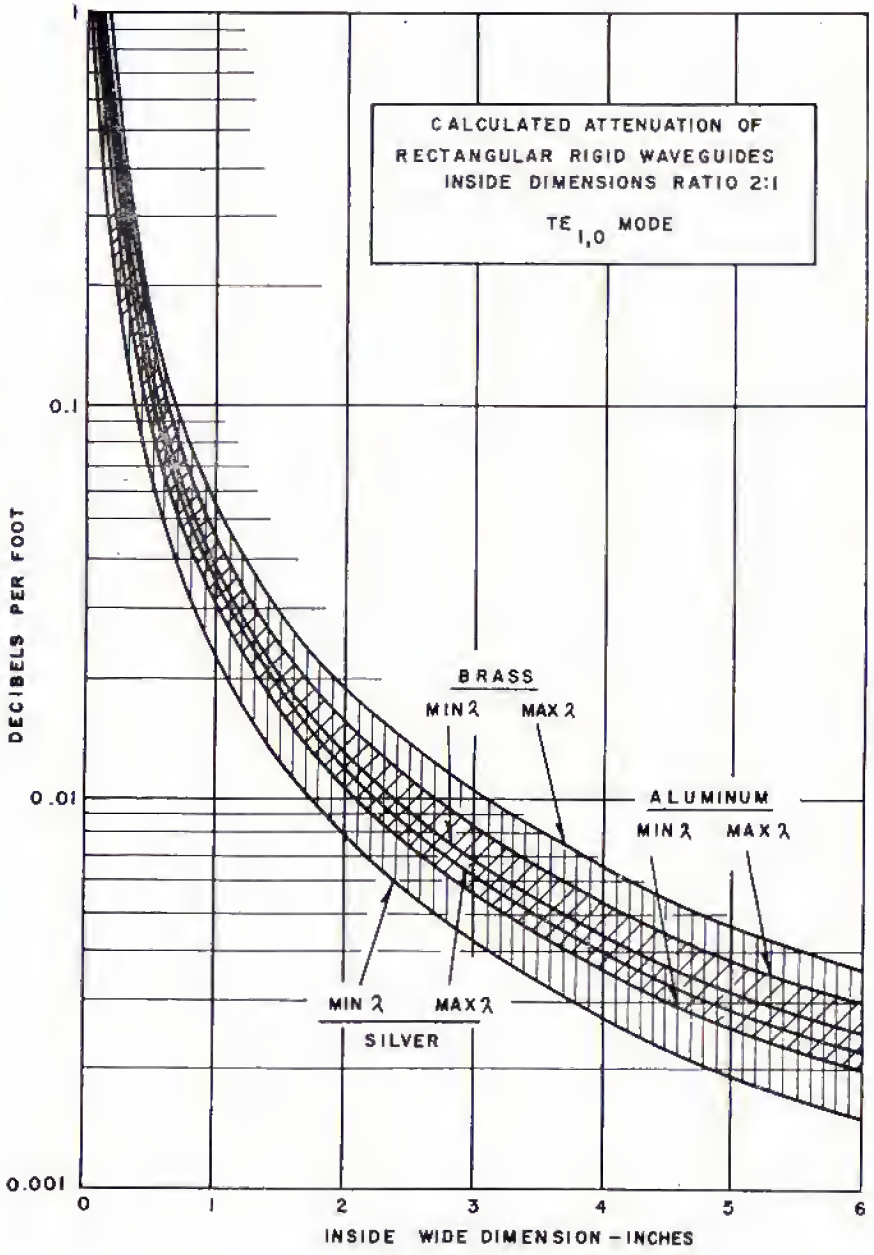
WHERE

r = REFLECTION COEFFICIENT

r = VSWR

$$r = \frac{B}{A} = \frac{r-1}{r+1}$$


100
10
1.0
0
CENTIMETERS
MAXIMUM WAVELENGTH
MINIMUM WAVELENGTH
$TE_{1,0}$ CUT-OFF
OPERATING RANGE
BAND WIDTH
NORMAL
$TE_{2,0}$ CUT-OFF
OPERATING RANGES OF RIGID RECTANGULAR WAVEGUIDES $TE_{1,0}$ MODE
0.1
1.0
10
100
INSIDE WIDE DIMENSION – INCHES


1
0.1
0.01
0.001
DECIBELS PER FOOT
CALCULATED ATTENUATION OF RECTANGULAR RIGID WAVEGUIDES INSIDE DIMENSIONS RATIO 2:1 $TE_{1,0}$ MODE
BRASS
MIN λ
MAX λ
ALUMINUM
MIN λ
MAX λ
MIN λ
MAX λ
SILVER
0
1
2
3
4
5
6
INSIDE WIDE DIMENSION – INCHES